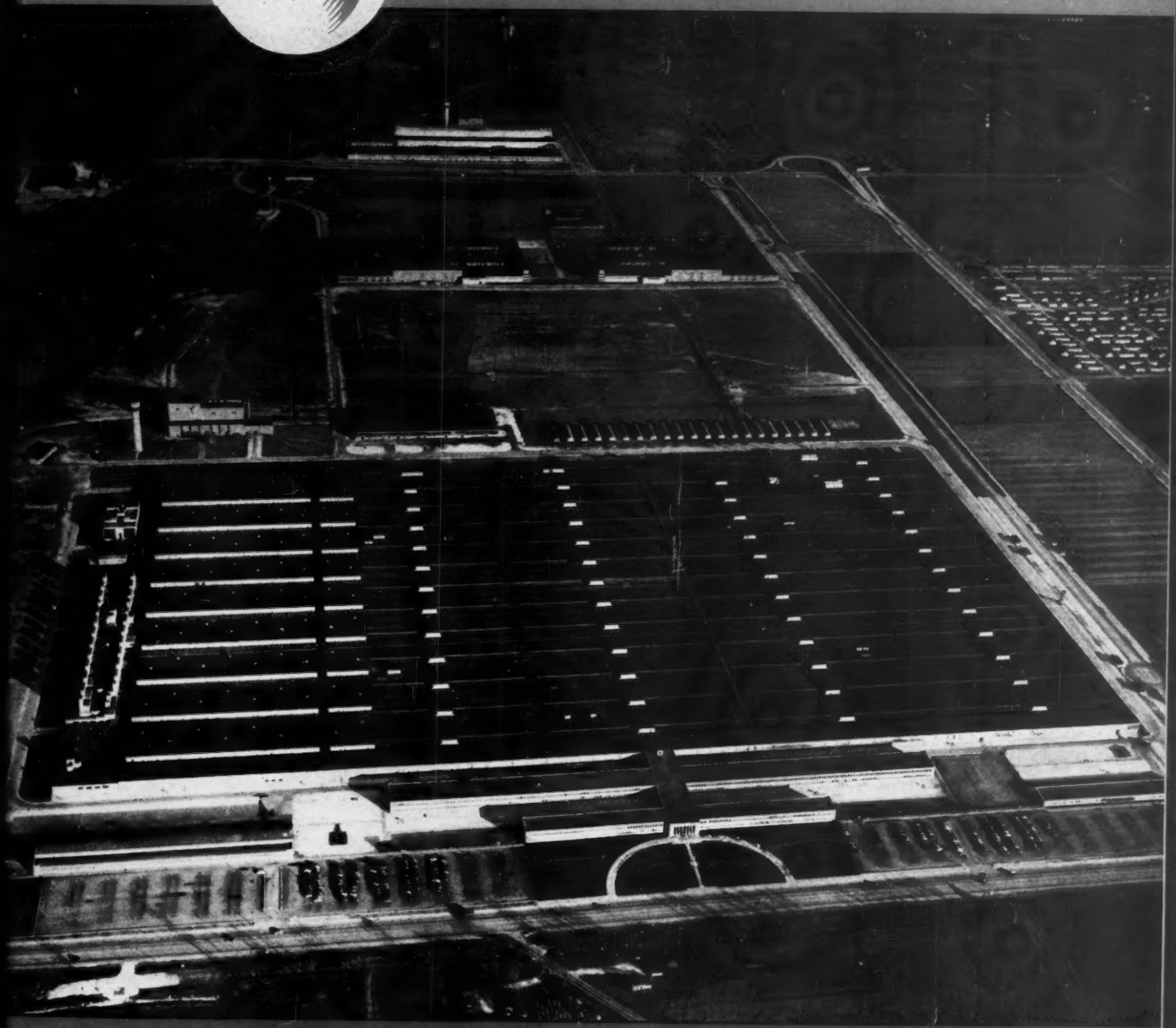
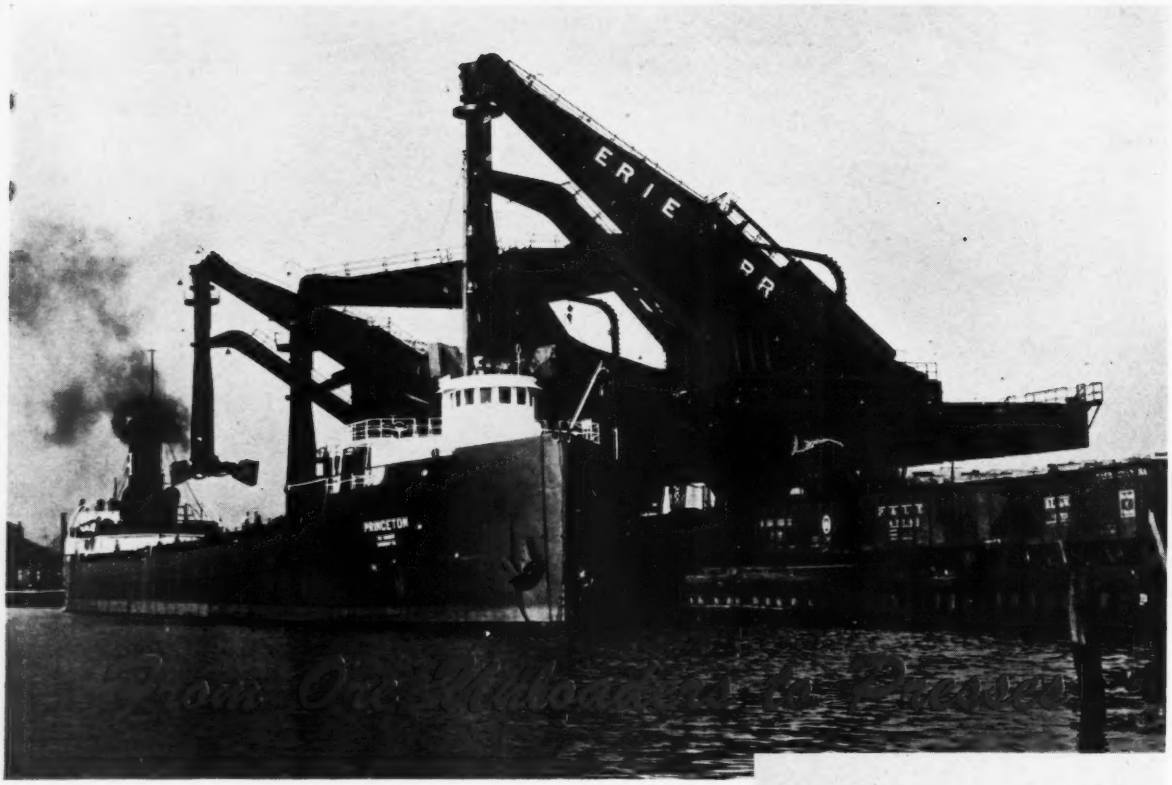
AUGUST-SEPTEMBER, 1947
Vol. 3 - - - - No. 3

Lubrication ENGINEERING

Photo shows the gigantic Dodge Chicago plant which will house the 1947 Machine Tool Show from September 17 through September 26. Complete story on page 15.



JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS



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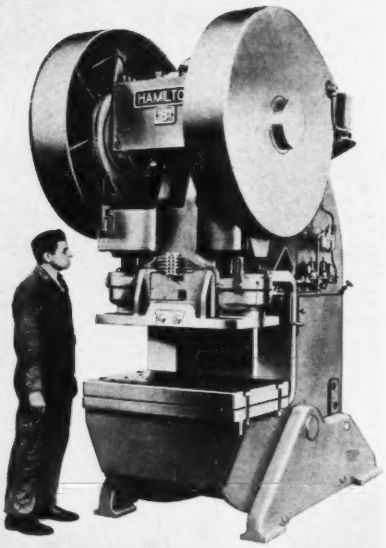

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Lubrication Engineering

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A·S·L·E

LUBRICATION ENGINEERING
Official Publication of the American Society of Lubrication Engineers
343 SOUTH DEARBORN ST., CHICAGO 4, ILL.

BURGESS H. JENNNGS, Editor
Northwestern Technological Institute, Evanston, Ill.

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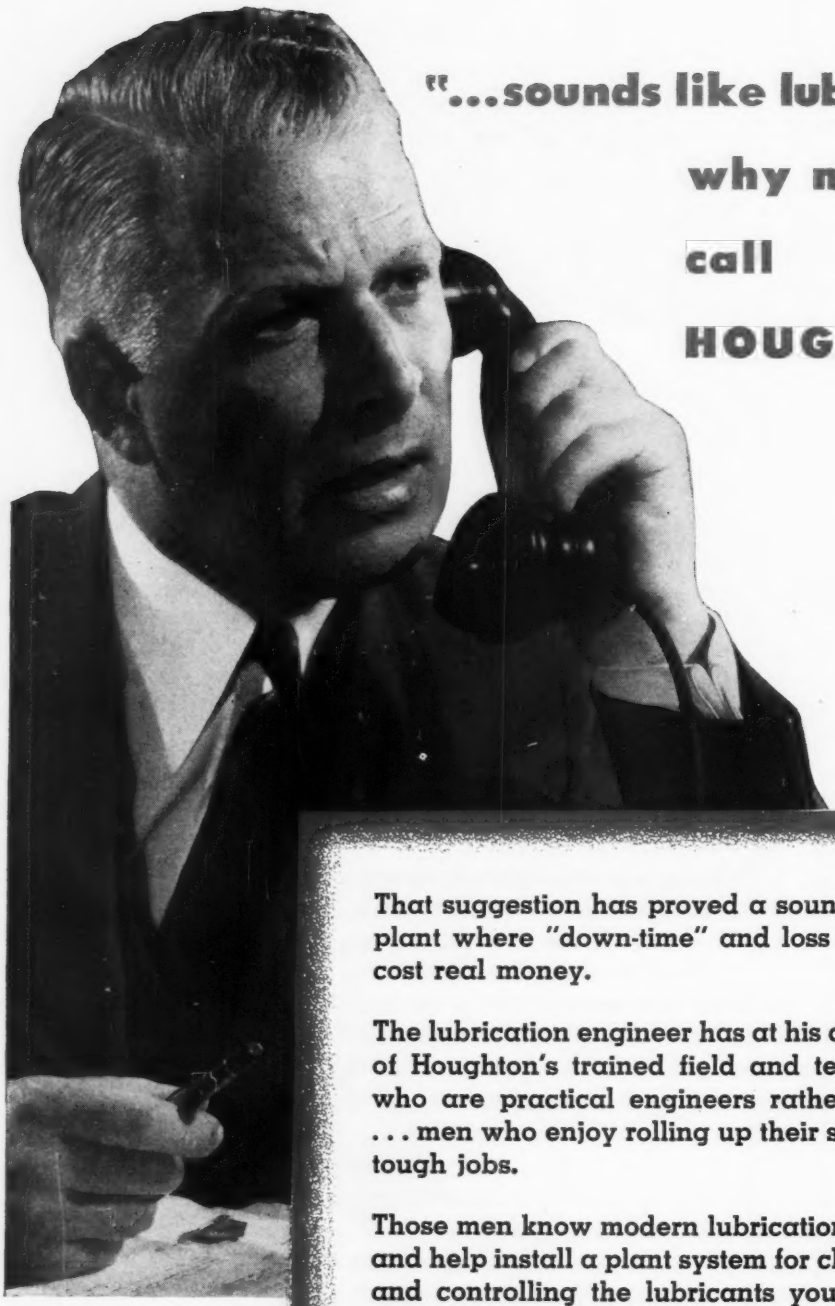
Address correspondence regarding contents, manuscripts, etc., to the editor at Northwestern Technological Institute, Evanston, Ill.
Inquiries regarding advertising space and rates should be addressed to W. F. Leonard, Lubrication Engineering, 343 S. Dearborn St., Chicago 4, Ill.



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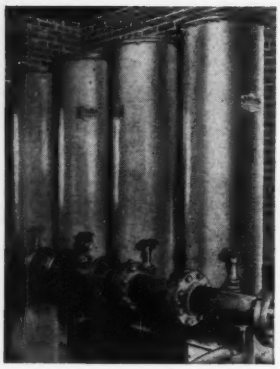

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EDITORIAL

There's *Gold* in Human Engineering

Every now and then your editor in reading runs across items which he feels are so good that he just itches to pass them on. This month's editorial is such an item. It was written by W. B. Pierce, President of the A.S.T.E. and it has already appeared in The Tool Engineer. Perhaps some of you have read it, but even if you have your editor is not worried, as it is well worth reading again and often.

SKILLED observers who have kept sensitive fingers on the pulse of our industrial democracy warn that steps must be taken quickly and intelligently to improve human relationships in industry. If their warnings are not understood and heeded, strikes will increase both in number and intensity, production cannot be maintained, and those peddling collectivist and authoritarian ideologies will find more fertile ground upon which to sow their destructive seed.

Experts in the field of industrial relations, with a preference for long words, use the term "psychological factors" in describing the influences which improve or impair the relationships of individuals and groups. The rapidly developing science of understanding and controlling these factors is sometimes referred to as "human engineering." This is a rather realistic term and one that can be appreciated by men in industry who deal with human problems.

A scientific approach to problems of industrial relations has a definite dollars and cents value. Controlling some of the factors involved is solving for some managements an ever increasing number of problems of many and sundry varieties. The more common ones are: decreasing absenteeism, increasing productivity per man hour, developing pride in workmanship, improving company spirit and loyalty, and preventing strikes.

One has to but realize that 139,000,000 man days were lost in 1946 because of strikes to appreciate what might be accomplished in actual dollars and cents through the practice of better human relations.

Speaking recently before a group of public relations executives in New York City, Dr. Claude Robinson, President of Opinion Research Corporation, Princeton, New Jersey, had this to say:

"A strike is a psychological phenomenon that results from clashing ambitions of men or groups of men and from ignorance of fact. In good part, strikes occur because of faulty communication."

Dr. Robinson means that in too many cases the lines of communication between the carpeted sanctum and the shop are in bad order. The men in both domains must, through improved communication and thus a better understanding of each other, learn to live together with tolerance. The lines of communication must be put in order and kept clear.

In our communications, it must be kept in mind that all men are motivated to action by two factors: intelligence and emotion. The conduct of the vast majority springs largely from emotional thinking. It is, therefore, necessary to inject a great deal of enthusiasm coupled with simple logic into any human relations program, if it hopes to gain popular support. Enthusiasm is contagious, especially among individuals who react largely from their emotions. Thus, proper efforts will usually be rewarded with the development of the capacity for enthusiasm among both workers and executive employees.

Teaching people to be emotionally stable and mature is a long, hard process . . . and virtually impossible in a great many cases. But skilled human engineering technicians have developed techniques and avenues of communication that are working wonders in a great many enterprises. They have learned to utilize to the fullest the benefits of such media of expression as plant bulletin boards, employee publications, visual aids, public address systems, ordinary letters, and hundreds of other ways of reaching individuals and groups.

There is enormous potential power in properly-organized, skillfully-executed industrial and human relation programs. They must be carried out by personnel or agencies who understand the techniques.

There is gold in these unmined hills if only business and industry will dig for the answers in human engineering. Good attitudes through good relationships mean profits on the company's balance sheet and money in the worker's savings account.

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LUBRICATION ENGINEERING

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Mineral Lubricating Oils

PART 1

By EDGAR S. ROSS
Sun Oil Company, Philadelphia

Edgar S. Ross. Chemical Engineer, Industrial Chemist and Master Mechanic. Dr. Ross is widely known as an authority on lubricants and lubrication, and has contributed much in the development of Refrigeration Oils.

Serving as Chief of the Lubricants Section, Refining Division, Petroleum Administration for War, Washington D. C., he later resumed his former connection and is now Technical Representative, Industrial Products Division of the Sun Oil Co., Philadelphia.

I. Introductory and General

THE KEYNOTE of all business today is efficiency and service. The world has been engaged in the most gigantic combat in history and one result of this world-wide conflict is that the United States has experienced its greatest era of manufacturing activity and mechanization.

Economical, efficient, dependable and uninterrupted operation of mechanical equipment, utilization of every available horsepower, every machine tool in operation every hour of the day is of utmost importance.

Petroleum and its many products are closely involved in some phase of every manufacturing process where mechanical equipment is used. The severe lubrication requirements of modern machinery and mechanized equipment—on land and sea, in the air and under water—make unusual and increasing demands on the ingenuity of refiners and industrial lubricating engineers for the production and utilization of petroleum lubricants, as well as motor fuel, aviation gasoline, domestic and industrial fuel oils.

None of this vitally essential machinery, industrial, commercial and civilian, as well as military, could possibly operate dependably and efficiently without high grade petroleum lubricants suitable for the many types of service. The public does not realize, for instance, that the compressor in each one of the more than 15,000,000 domestic refrigerators in use today operates in a "bath of oil", especially refined to last for the life of the refrigerator.

Furthermore, the milk industry, meat packing, frozen fish and food industry, every soda fountain, food display case, beverage cooler, 45,000 air-conditioning units, 4,500 locker storage plants in farming centers and small communities, 1,500 cold-storage warehouses, depend upon complicated refrigerating equipment which could not operate without suitable refrigerator oils supplied by the refiners. Air-conditioning equipment in offices, schools, theatres, restaurants and hospitals, the 150,000 refrigerated milk and freight cars carrying food products, the banana and fishery ships, all depend upon lubricating oils to protect the vitally essential refrigeration machinery needed to preserve these valuable cargoes.

The public consumes over 300,000,000 gallons of ice cream per year, about two billion pounds of butter, about 120,000,000 pounds of cheese, and several million bottles of beer; it stores valuable furs in order to protect them against deterioration by moths. All the equipment to produce and preserve these necessities and luxuries depends on special lubricating oils for uninterrupted, efficient operation.

Many industrial processes, such as Rayon, Nylon and Celanese, compressed gases, sugar refining, petroleum refining, bakeries, candy manufacturing, wineries, soap manufacture, tobacco and paper industries, biological laboratories, surgery, mortuaries and many other diversified activities, rely on mechanical refrigeration. The "heart" of every refrigerating machine—the compressor—depends upon lubricating oil for continued, dependable and efficient operation.

Little does the average person realize the extent and importance of the role that refrigeration played in the recent world war. What an amazingly fascinating story someone could write about our "floating refrigerators" or refrigerator ships, refrigerated planes and mobile refrigerating units for sea, air and land, to meet the vital needs of our military forces. Without detracting one bit from the other vital phases of our war activity, one might reasonably raise the question—"Where would we have gotten in our war effort without adequate refrigeration and the many things it has made possible?"

Man's first lubricants were animal fats and later vegetable oils were used, both of these remaining in use for hundreds of years until replaced by mineral oils. Today they still find some limited use as compounding agents admixed with mineral oils for special applications.

The animal and vegetable oils have a tendency to combine with oxygen and to be converted to sticky, solid, elastic varnishes; in other words, they are more susceptible to oxidation than mineral oil lubricants.

Vegetable oils used were largely Castor, Rapeseed, Cottonseed, Olive, Cocoanut and Palm Oils. The Animal Oils were Tallow (derived from the fat of cows, oxen, sheep, etc.), Lard Oil, Sperm Oil (found in the head of certain whales) and Whale Oil (extracted from the blubber of Arctic whales).

Having touched briefly on the lubricants that were replaced by mineral oils, it may be appropriate to also touch briefly on the subject of replacements for mineral oils. In view of the tremendous increase in crude oil production since the Pearl Harbor episode there are those who have raised the question—"After exhaustion of our crude oil supplies, then what?"

Although this problem will, in the opinion of competent oil men, not become acute for some years, the U. S. Government and the American Petroleum Industry have not ignored such a possibility. We have in the United States large oil shale and bituminous coal deposits which can be processed to yield motor fuels and lubricating oils. Research has been and is being conducted in experimental plants in order to develop efficient processes for the utilization of these national resources and to protect our country against a possible shortage of essential petroleum products.

Paper delivered in abstracted form before the Chicago Section, American Society of Lubrication Engineers, on January 25, 1946.

Oil shales are found in some abundance in a number of our Western States and by destructive distillation the potential yield of crude oil from the Colorado-Utah shales alone is estimated at 1,000 billion gallons.

Bituminous Coal lends itself to processing for the production of petroleum-like material by doubling the hydrogen atoms and removing oxygen, nitrogen and sulfur. The so-called "Bergius Process for Hydrogenation and Liquefaction of Coal" is well known.

The "Low Temperature Carbonization of Coal" is a heat treatment of coal in the absence of air, which gives a fairly good yield of liquid products and a solid, smokeless fuel.

Synthetic petroleum-like products are obtained by the Fischer Process which converts coke from low temperature carbonization of coal to carbon-monoxide (CO) and adds hydrogen to that gas at high pressure and temperature to produce motor fuel, oil and tar.

The United States reserves of bituminous coal and lignite are considered to be practically "inexhaustible" and we still produce 63% of the total world oil production. Production and refining costs for these "petroleum substitutes" are still quite high when compared to our present natural petroleum crude and its products but "as, if and when" the actual need arises for the production and use of these substitutes, such costs will undoubtedly fall to a more practical basis.

More recently attention has been directed to certain chemical compounds said to possess lubricating properties. Specifically, these are the new silicone compounds on the one hand and glycol-type product on the other hand. These new products have been undergoing rather extensive examination as to suitability for lubrication purposes, and it is still too early to pass final judgment.

The following sections of this paper will be directed specifically to the processing of crude oils for the recovery of lubricating oil distillates and the refining of these distillates into various grades of lubricating oils. The essential characteristics of oil will be discussed; first, as to their significance where oils are used for general lubrication, and, second, as to their significance when used specifically for the lubrication of refrigerating system compressors. A final section covers various methods of lubrication of equipment in the refrigeration and air-conditioning fields.

II. Petroleum—Basic Source of Lubricating Oils

(a) Composition:

Petroleum is composed almost completely of carbon-hydrogen compounds, although there are usually present small and variable amounts of sulfur, oxygen and nitrogen. Statements in the petroleum literature indicate that the last three comprise from 0.5 to 4.5% of the oil, and in modern applications of petroleum products usually are considered undesirable constituents. The crude usually contains from traces to a few hundredths of a per cent of inorganic salts.

The percentages of carbon and hydrogen in petroleums from all parts of the world do not vary widely, the carbon being from 83 to 87%, and the hydrogen from 11 to 14%. The ultimate analyses consequently give but little indication of the extremely varied physical and chemical characteristics of the different petroleums.

The main homologous series of compounds found in petroleum are the paraffins, naphthenes, and aromatics. Asphaltic material, which is a product of partial oxidation of hydrocarbon material is also present. This subject will be discussed in detail subsequently.

(b) Classification:

The three major classifications of crudes are paraffin base, naphthene base, and mixed base. Paraffin base crudes contain very little asphalt, but yield solid paraffin hydrocarbons commonly known as paraffin wax. Some of the well-known paraffin base oils are those from the Pennsylvania, West Virginia, North Louisiana, and certain of the Mid-Continent (Oklahoma and Kansas) fields. The naphthene base crudes on distillation leave as a residue, a heavy pitch or asphalt. Predominating in this residuum are hydrocarbons with both naphthenic and aromatic characteristics. California, certain Gulf Coast, and the heavy Mexican oils are in this class.

As the name would indicate, mixed base oils contain both of the above compounds—wax and asphalt. Illinois, some of the Mid-Continent and light Mexican crudes are of this class.

III. Processing of Crude Petroleum

(a) Processes Used:

Regardless of the subsequent treatment, the first step in processing a crude oil is distillation into a convenient number of fractions. The lower boiling constituents are first removed for specialized fuels. Modern refining accomplishes this in a continuous manner by heaters and distillation columns. Following the removal of non-lubricating oil fractions, the residue containing the desired oils is heated to sufficiently high temperatures to effect further fractionation under high vacuum or is temporarily permitted to remain as a long residuum.

At this point the more specialized refining steps required for specific lubricating service are applied. If the lubricating oils have been fractionated, they may be refined by acid treatment, solvent refining, and clay filtration. Should the oils have been left as a long residuum, they may be solvent refined or treated otherwise, with final separation by distillation into cuts of various viscosities appropriate for application as lubricants. When required, oils containing waxes are freed of these components by chilling and filtration, with or without solvents.

(b) Distillation Products Obtained:

The following classification is not intended to include all possible distillation products but only those fractions of major significance to the refiner:

1. Hydrocarbon gases.
2. Light distillates—gasoline, naphtha, kerosene.
3. Intermediate distillates—gas oil.
4. Heavy distillates—lubricating oil, wax.
5. Residues — lubricating oil, waxes, fuel oil, road oil, asphalt, coke.

The relative proportions of these products obtained with a given crude depends not only on the nature of the crude, but also on the distillation process or processes employed and the objectives sought.

(c) Lubricating Oil Distillates:

The various lubricating oils produced by distillation have constituents boiling from about 500F at atmospheric pressure, to 700F under high vacuum. A distillate from a naphthene-base crude which has received no additional treatment, or only a very mild treatment has a tendency to form sludges, under moderate or severe conditions of service and must, for certain applications of the oil, be consequently given additional refining. As a rule naphthenic oils have the property of avoiding the formation of corrosive acids. A distillate from a paraffin-base crude has less tendency

toward sludge formation but can be expected to form more corrosive acids under more severe conditions of service. Wax, which is also present in paraffin distillates, usually must be removed. Mixed base crude has characteristics intermediate to the two types mentioned above. For use as lubricants, oils from these three sources usually require additional processing to give the oils optimum characteristics for any particular service. These steps may encompass acid treating, solvent refining, clay filtration, selected additives, etc.

The lubricating oil fraction of a crude is separated into a number of distillate cuts covering a wide range of viscosities, enabling an appropriate selection of a lubricant to be made for specific applications, or conversely, to permit blending of the various grades to the desired properties.

IV. Constitution of Lubricating Oil Distillates

As mentioned previously, the main families of hydrocarbons found in the crude petroleum are the paraffins, the naphthenes, and the aromatics. These are accompanied by small amounts of:

(a) Paraffins:

These are saturated hydrocarbons of the general formula C_nH_{2n+2} and exist as straight or branched chains carbon atoms saturated with hydrogen. The first four members of this family are gases. Those members of this family having boiling points similar to lubricating oil fractions are solid waxes at ordinary temperatures. Since paraffins do not occur in lubricating oils except as waxes, they are usually removed more or less completely during de-waxing.

(b) Naphthenes:

These are saturated compounds having the general formula, C_nH_{2n} and consist of closed chains of methylene groups, CH_2 to form ring structures. Simple ring structures of naphthenes without side-chains have not been encountered in lubricating oil fractions. Naphthenes occur as substituted five or six carbon rings or similar polycyclic groups.

(c) Aromatics:

These are unsaturated compounds based on six carbon atom rings of the formula C_nH_{2n-6}. The simplest member is benzene, C_6H_6. Simple aromatics do not exist in lubricating oils, but are found as paraffin or napthene substituted aromatics. Polycyclic aromatics, having more than one ring group can also be found.

It may be well to mention at this point that the various crudes are not composed of the typical hydrocarbons mentioned. That is, a paraffin-base crude does not contain oils composed only of paraffin molecules, or a naphthene-base crude of naphthenes. Actually the molecules of the oils are complex compounds covering all types. The characteristic differences are due only to that type of structure which predominates in the average molecular structure of the oil.

(d) Miscellaneous:

Olefins (C_nH_{2n}) and Diolefins (C_nH_{2n-2}) have been mentioned before as not occurring in crude oil, but probably existing only as a result of thermal cracking occurring during processing. The unsaturation of olefinic compounds leaves them unstable to oxidation.

Oxygen compounds are found in crudes and can be present in distillates or residue prior to additional refining. Oxygen appears in crude as naphthenic acids, phenols and in the complex structures of asphalt and resinous compounds.

Sulfur occurs in a variety of compounds in crudes, but is removed to a degree commensurate with the extent of refining. Sulfur appears in forms varying from simple mercaptans to complex structures in mixed ring compounds encountered in asphalts. The system of nomenclature is such that no attempt is made here to name the compounds.

Nitrogen is also present in lubricating oil fractions. The available literature references would indicate that it exists in mixed rings such as the substituted quinolines.

V. Refining or Lubricating Oil Distillates

The general object of lubricating oil refining is the improvement of oil properties and rendering oil suitable to service conditions. Oil properties can be improved, however, in a variety of ways which may be classified as follows:

1. Removal of undesirable constituents from the crude products.
2. Converting undesirable constituents into desirable ones by changing their chemical structure through hydrogenation, condensation, or other processes.

The removal of deleterious substances is the more important of the above approaches at present. To varying degrees, the undesirable substances include wax, asphaltic and resinous materials as well as oxygen, sulfur and nitrogen bearing constituents. The degree to which these are removed depends on their character and the ultimate use to which the oil is to be put. The use of additives which are chemical compounds designed to prevent deterioration of the oil, or to give it properties which it cannot exhibit naturally, is becoming as important as the removal of unwanted constituents.

With few exceptions, all petroleum products must be treated in some manner in producing finished market products. The impurities that must be removed are usually present in the crude oil, but some are produced during prior refining operations. Some of the purposes of treating are:

1. To improve color.
2. To improve odor.
3. To remove certain sulfur compounds.
4. To remove resinous and asphaltic substances.
5. To remove organic acidic compounds.
6. To improve stability on exposure to air and light.
7. To change physical properties of the oil.
8. To change chemical properties of the oil.

Not all stocks need to be modified in all of the above respects, but in certain stocks or for specified uses, most of the above may be involved. The two main classes of treatment are Sulfuric Acid Refining and Solvent Refining. Clay treatment might also be classified as a third method, even though it is often used in conjunction with the first two. Sulfuric acid involves both chemical and physical action. Solvent treating is a physical process, and Clay treating is chemical, physical or both, depending on the application. Both acid and solvent treating are quite flexible, and in a broad sense, produce somewhat similar changes in an oil. The paths along which these changes take place are sufficiently different, however, that the final products are usually different even though starting from the same stock. The choice of methods thus depends on many other factors such as source of crude, desired characteristics of final products, and economics.

VI. Properties of Lubricatng Oils and Significance of Tests

Lubricating oils have been evaluated according to various physical and chemical tests in the past. It is desirable to discuss the significance of the common tests and indicate the present trends. It is unfortunate that too great a reliance has been placed in the past on many of these tests. The A.S.T.M. booklet, "The Significance of Tests of Petroleum Products," gives a general discussion on this subject and takes care to point out that too great reliance cannot be placed on these tests in relation to the prediction of the ability of a lubricant to perform well in service. For many years, however, since more suitable tests were not available, their use has become very extensive. More recently performance type tests are being developed for various type services which are much more instructive in estimating the suitability of a lubricant.

(a) Gravity:

In the petroleum industry gravities are expressed in °A.P.I. The specific gravities of crudes vary roughly from about 0.750 to 1 depending on the definition of a crude oil. The paraffin-base crudes have lower specific gravities (higher A.P.I. gravities) than the naphthene-base crudes. For a given oil, the gravity is an index of the boiling point. As a specification item its value is in question and carelessly written specifications on gravity may eliminate some highly suitable oils. For oils of equivalent viscosity for a specific service, naphthene-base oils may run 5 to 10 units in A.P.I. gravity lower than paraffin-base oils, with mixed-base oils in between. Refining a distillate increases the A.P.I. gravity whether the refining agent is acid, solvent or clay.

(b) Viscosity:

The viscosity or coefficient of internal friction is that property of liquid substances responsible for resistance to flow.

For lubricating oils, viscosity is extremely important since it determines the bearing friction, heat generation and rate of flow under given conditions of load, speed, and bearing design. The oil shouid be viscous enough to maintain a fluid film between the bearing surfaces in spite of the pressures tending to squeeze it out but not too heavy to cause drag, loss of power and increase in operating cost. Furthermore, when considering refrigerator lubricants, too heavy an oil will not drain sufficiently from evaporator coils should it be carried over by refrigerant. When two oils, a paraffin-base and a naphthene-base, having the same viscosity at the given operating temperature, are being used on very heavily loaded surfaces, the naphthene-base oil tends to offer additional protection by virtue of its property of increasing viscosity with increased bearing pressure more rapidly than does a paraffinic oil. The increase in bearing pressure tends to reduce oil film thickness and the naphthene-base oil compensates for this by becoming more viscous, thus keeping bearing surfaces out of contact.

(c) Viscosity Index:

The viscosity of all petroleum oils becomes less as the temperature is raised. This fact becomes important in the selection of a lubricant for some types of service. An oil must be selected which will be sufficiently fluid to permit starting equipment at lower temperatures, and sufficiently viscous at operating temperatures to maintain proper lubrication. The rate of change of viscosity with temperature for any oil depends on its chemical constitution. A paraffinic oil has a less rapid change of viscosity with temperature than does a naphthenic oil. The Viscosity-Index is an empirical expression of this characteristic and relates any particular oil in this regard to two arbitrarily selected oil types. These two types were labeled O.V.I. for the oil whose viscosity changed most rapidly with temperature (Naphthenic Oil) and 100 V.I. for that which had the least rapid change (Paraffinic Oil). If an oil has been properly selected for the desired service, its Viscosity Index bears no relation to its ability to perform its lubricating function under operating conditions. Other considerations may result in the selection of a desirable Viscosity Index range, however, such as extremely wide operating temperature ranges benefited by high V.I. oils, desire for the natural low pour points as encountered in low V.I. oils or other considerations. Sometimes the Viscosity Index of an oil is artificially raised by the use of additives. If the elevation thus attained is great, the usual chemical characteristics associated with normal high V.I. oils do not exist, and its chemical reactions in service still remain to be those of the oil from which it was derived.

(d) Viscosity-Gravity Constant:

This numerical constant relating the viscosity and the gravity of an oil was developed for classification of crudes. Like the Viscosity Index, it has often been utilized far beyond its original intended purpose. While it does give some indication of the chemical constitution of an oil, its most useful field is in plant control within the refinery, and should not be used as an item of specification. Typical Viscosity-Gravity-Constant values for crude oils are 0.810 for Pennsylvania type; 0.846 for Mid-Continent types; and 0.880 for Gulf Coast crudes.

(e) Flash and Fire Points:

These are very commonly encountered in specifications, but are becoming less informative in modern lubricants as will be pointed out. For a refined oil, the Flash Point represents the temperature at which just sufficient vapor has been produced to flash or momentarily burn when exposed to a flame. The Fire Point represents the temperature to which the oil must be raised to support continuous combustion. In general, the Flash and Fire Points of Naphthenic oils are somewhat lower than for Paraffinic oils of the same viscosity. The values for oil blends are intermediate to those of the oils composing the blend. Flash and Fire specifications were originally employed to indicate the fire hazard of petroleum products, but their uses were extended far beyond this and often misapplied. The use of additives in modern lubricants sometimes results in a lowering of Flash and Fire points. This cannot be considered as detrimental since the finished lubricant, so blended, can be expected to give superior service to the base oil from which it was prepared. While Flash point does give an indication of the relative volatility, it is not an index of oil consumption in an engine, nor a measure of suitability for refrigerator lubrication.

(f) Pour and Cloud Points:

All oils will congeal or cease to flow if cooled to a sufficiently low temperature. It is convenient to have a method of estimating the relatively low temperature flow characteristics of lubricants in a number of services. For example, it is desirable to have an oil that will flow at low temperatures when starting automotive engines in cold weather, or to be assured that an oil used in a refrigerating system will flow readily at the lowest temperatures encountered. As an oil is cooled under the prescribed conditions of test, it may show a cloudy or hazy appearance due to the separation of wax. This is

known as the Cloud Point, and may or may not coincide with the temperature at which the oil no longer flows under the method of test. The temperature at which flow ceases under the conditions of test is known as the Pour Point. Cessation of flow at this point can be due to wax solidification in paraffinic oils, or the fact that viscosity increase due to cooling of a naphthenic oil no longer permits ready flow. The Pour Point is not an absolute indication of the temperature at which the oil is no longer usable under actual service conditions, but is indicative only. Pour depressants are used at times to prevent, to a certain extent, the solidification of wax in paraffin oils. Naphthenic oils exhibit Pour Points normally much lower than are achieved with paraffinic oils of comparable viscosities.

(g) Acid and Base Number:

Practically all crude oils contain substances having acidic characteristics, usually of organic composition. These acid constituents appear in lubricating oils to an extent dependent upon the method and degree of refining, and are not necessarily indicative of improper refining or poor quality. Many of these naturally occurring acids are not corrosive to metals in service. It became common practice to specify that a lubricating oil should be neutral by a specified test method, however, to indicate that it had been carefully refined. The same careful refining is still of importance today, but the advent of additives in lubricants to achieve new properties and advantages often results in the finished oil having an Acid or even a Base number. In such oils, the measurement of acidic characteristics is not cause for condemnation and the application of service tests will demonstrate the superiority of that type of modern lubricant.

(h) Carbon Residue:

Ramsbottom carbon residue or Conradson carbon are frequently used for estimating the carbonization properties of lubricating oils in engines or other hot service. In this test the oil is vaporized at atmospheric pressure by heating and the residue is reported as per cent of the charge. The nature of the carbon as well as the amount is significant. In an automobile engine, a light fluffy carbon is more desirable than a hard adhesive form since the former will be removed with the exhaust gases. Paraffin-base oils form the hard carbon and naphthene-base oils form the soft carbon residues. Refrigerator compressor oils must be sufficiently well-refined to avoid deposit of hard adhesive carbon when exposed to "hot spots" in a refrigerator cycle.

(i) Emulsification:

When oil and water are mixed, they tend to separate more or less rapidly on standing. The presence of small amounts of certain other materials decreases the rate of separation and may prevent any separation whatever. For certain purposes emulsification is highly desirable, as in lubrication and cooling of special metal-cutting tools; for other uses, emulsification may be highly undesirable, as in the lubrication of steam turbines. In the laboratory, the emulsification is evaluated by the performance of the oil under standard tests such as the steam emulsion test, emulsion test, and demulsibility. For steam turbines the steam emulsion test has been considered very important. The American Society for Testing Materials has a special committee which is reconsidering the actual practical significance of Steam Emulsion specifications as applied to Turbine Oils. The steam emulsion and demulsibility tests are very sensitive towards addition agents which may be there to modify some other characteristic of the oil.

(j) Oxidation Stability:

This is an extremely important characteristic for many services. Oxidation of an oil produces many physical and chemical changes usually resulting in lowering its efficiency as a lubricant. Many tests have been devised to evaluate the ability of an oil to resist oxidation for various types of service. The stability is measured by determining the amount and rate of change involved. Increase in viscosity, acidity, sludge, resin content, carbon residue, color, etc., are a few of the common values followed during the course of the test. The closer any test procedure approaches the actual service conditions, the more reliable the results. This is unfortunate since it is highly desirable to avoid long-time testing and consequently short accelerated test procedures are always being studied, to improve their ability to evaluate oils for various services. Laboratory studies are, however, devising testing methods which are continually becoming more reliable and instructive. It is difficult to eliminate the service conditions that promote oxidation, and, as a matter of fact, modern equipment design usually results in more stringent conditions due to designing for greater efficiency, less weight, size, etc. There are limits beyond which lubricating oils cannot be processed to have an ideal long life. The use of additives to enhance the desirable properties of a lubricating oil has become common practice. Oxidation inhibitors are prominent among these. Inhibitors must be carefully selected to give optimum results, and it is necessary to consider the type of oil, its refining, and the use for which it is intended. Compounds of phosphorus, tin, sulfur, arsenic, as well as hydroxy compounds, amines, phosphatides, and many others, have been used for this purpose.

The desire to improve certain characteristics of an oil by extensive refining can often result in detrimental effects. A number of years ago solvent refining was used to lower sludging tendency, with the result that over-refining with respect to bearing corrosion was encountered. The hard alloy bearings of copper-lead or cadmium-silver were readily attacked by the acids formed during oxidation. This condition has been overcome by the use of additives which not only prevent the corrosion, but maintain the advantages resulting from the refining in other respects.

Ill-advised purchase specifications have sometimes resulted in forcing the refiner to supply oils which are over-refined for the intended service, such as White Oils in some refrigerators or turbines. Such applications result in a lubricant which deteriorates, once it has started, at an extremely rapid rate as contrasted with a properly selected oil whose deterioration is appropriately slow and steady.

(k) Sligh Oxidation and Acid Absorption:

Sligh Oxidation at one time was extensively used in specifications, and was thought to be a measure of the oxidation tendency of the oil. However, the most useful application of the Sligh Oxidation test is in refinery control wherein its trends are related to the degree of refining the oil has received. The Acid Absorption Number is a test having a similar value in the refining of an oil. This test gives data indicating in a general way the degree to which aromatic content has been removed or modified during refining. For any one source and refining method, Sligh and Acid Absorption values are re-

(*Continued on page* 48)

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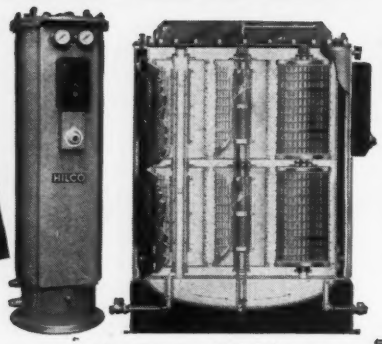

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● For lubricating oil or storage to engine fuel oil filtering using 5" x 11" and 7¼" x 18" Filter elements. Easy and quick to service.

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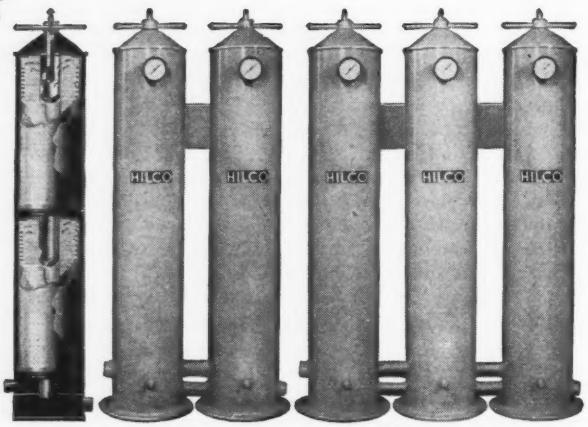

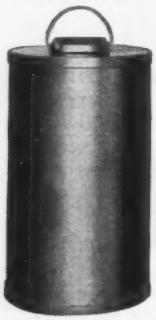

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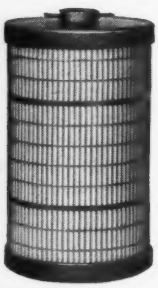

Both are interchangeable at any time.

● Hilco Hyflow Oil Filters use Hilite-Fuller's Earth for filtering straight mineral and fuel oil or Hiltex-Cellulose, the all-purpose filtering media for heavy duty detergent oils and fuel oil.

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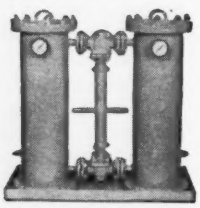
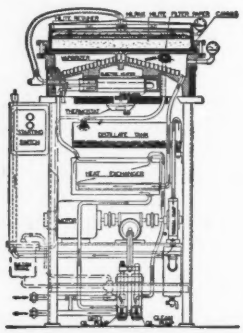


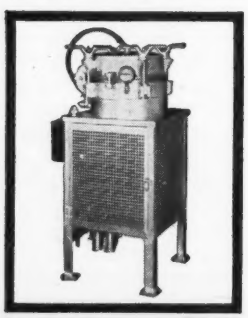
HILCO OIL RECLAIMERS



● For Lube and Bulk Fuel using one or a multiple of 7¼" x 18" Filter cartridges offering the maximum in filter area and correct depth for high flow rates and efficient filtration. Available in simplex type with or without heaters, duplex without heaters.

● For direct connecting to one or more engines for perfect and complete lube oil purification—removing carbon sludge, abrasives, tarry matter, and acids, water and fuel dilution—and color restoration.

Hilite-Fuller's Earth for filtering straight mineral oils—ADSTAY DISCS for heavy duty detergent oils.



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THE HILLIARD CORPORATION 20 W. FOURTH ST., ELMIRA, N. Y.

NEWS OF INDUSTRY AND PERSONNEL

Treffeisen Named to Head Alemite Sales Division of Stewart-Warner Corporation

Senior Vice-President Frank A. Hiter has announced the appointment of Gustave Treffeisen, former Assistant Sales Manager of the Alemite Division of the Stewart-Warner Company, to the post of Sales Manager to succeed Charles I. Kraus, who has left the corporation to become Alemite distributor in Minneapolis, Minnesota. Mr. Kraus took over his new duties in Minnesota on August 1, terminating a service of 24 years at Stewart-Warner.

Gustave Treffeisen

Charles I. Kraus

A native of Chicago, Charles Kraus became associated with Alemite in 1923 after attending Northwestern University and the Armour Institute of Technology. In his new post he will direct the factory field force of sales engineers responsible for distribution and jobber contact in the automotive, industrial, farm, aviation, marine and other fields. He has for several years headed the Stewart-Warner Industrial Division. He has been a very active member of the American Society of Lubrication Engineers.

Mr. Treffeisen is a native of New Rochelle, New York, and came to Stewart-Warner in 1920 and has since served in sales and administrative positions, and more recently has been identified with the automotive and farm lubrication fields.

Congratulations to both Mr. Kraus and Mr. Treffeisen.

Program Committee

Dr. Henry E. Mahncke, Chairman of the Program Committee, announces the following members of this very important group: Mr. Melville Ehrlich, Co-Chairman. The committee includes: Messrs. B. B. Farrington, A. F. Brewer, N. C. Penfold, L. A. Danse and Dr. A. J. Strohmaier.

Dr. Mahncke states that they are very anxious to hear from the membership regarding suggestions as to the conduct of the convention or offers of possible papers to be presented there.

Rene J. Bender, who for the past 15 years was connected in an engineering capacity with the SINCLAIR REFINING COMPANY, has become Assistant to the President of SINCLAIR PETROLEUM COMPANY and will leave shortly for Addis Ababa, Ethiopia, where he will represent his company.

"Chief" Bender was for 10 years the editor of the SINCLAIR FIREBOX, in Chicago. Upon his return from two years of service in the U. S. Navy overseas, he was attached to the Home Office of the Company. He contributed many technical papers on fuels to various Engineering Societies and Technical Magazines.

O. C. Burger has recently joined the Gordon Lubricating Company of Pittsburgh, distributors of RPM Motor Oils and Lubricants, as Lubricating Engineer. Mr. Burger was formerly associated with Pure Oil Company and is a graduate of Carnegie Institute of Technology. Prior to his employment with Pure, he studied diesel power and electrical prime movers while doing engineering selling. His recent move to Gordon is part of the company's expansion program.

Mr. J. B. Tiernan, who is with the Lubriplate Division of Fiske Refining Company, Newark, New Jersey, has been recently transferred to take over the territory comprising Florida, Alabama and Georgia. He is lubrication engineer for this company.

We wish Mr. Tiernan the best of luck in his new assignment.

THE STORY BEHIND THE COVER

Only twelve short years ago a certain parcel of prairie land on the outskirts of Chicago near the Municipal Airport was entirely vacant except for the grazing of an occasional cow. Today this same parcel of land is covered by the world's largest industrial building under one roof, the huge Dodge-Chicago Plant devoted during the war to the production of engines for the B-29 bomber.

Twelve acres of this space will be occupied from September 17 to 26 by the greatest industrial exhibit ever to be held in the country. Sixteen million dollars worth of machine tools in actual operation will be on display during this time.

It is refreshing in this day of international misunderstanding, doubts and fears, to report an event which will bring together the outstanding, forward looking industrialists who are instrumental in bringing to the American people a realization of the potentialities of this great industrial nation.

No one of the expected 100,000 visitors should fail to be impressed by the size, by the unlimited range of possibilities under engineering control. No one can help but feel an inspirational uplift in envisioning new horizons.

This publication is devoting considerable space in this issue to this, the greatest of all assemblages of machines and ideas. We feel that the net result should bring to every visitor a new conception of the power of America.

Chemical and Physical Mechanism of Engine Preservative Oils

By Dr. Helen Sellei and
Dr. Eugene Leiber

Paper presented at the Second Annual Meeting of the American Society of Lubrication Engineers at Pittsburgh on March 18, 1947

INTRODUCTION

ENGINE OILS have been known as long as the development of the engines themselves. However, the term "Engine Preservative Oils," as understood today, is primarily a development arising out of World War II.

Engine Preservative Oils are concerned with both the visible and invisible factors of corrosion. By "visible," we are concerned primarily with the problems of preservation arising in the shipment of engines under a variety of exposure conditions being manifest in the deterioration of the ferrous parts. This is epitomized concisely by observers in the South Pacific that prior to the development of Engine Preservative Oils, shipments of engines literally "melted before one's eyes." By the "invisible" factors, we are concerned with the deterioration occurring during the "operation" of the engine arising from the acidic products of combustion and the degradation of the engine oil by oxidation. The present paper is concerned with the chemical and physical mechanism of the "preservative" phase of Engine Oils, although it should be understood that the concomitant properties of oiliness, resistance to oxidation and detergency are equally important phases in this branch of technology.

Nature and Structure of Rust Preventive Additives

The chemical additives necessary to meet the chemical and protective requirements of Engine Preservative materials, such as humidity, salt water immersion, and hydrobromic acid neutralization, fall into a few fairly well defined classes. While a study of the literature will reveal that major developments have taken place since about 1940, nevertheless, early investigators discovered a few of the groups, which are active in imparting rust preventive properties to straight mineral oils, e. g., as early as 1923, Howe and Libby (1) showed that a mixture of petrolatum, woolfat, i. e., common degras, when added to mineral oil, was more effective in protecting ferrous metals against rust than mineral oil itself. It was also very early discovered that the metallic soaps of fatty acids were likewise effective for the same purpose, (2). A real advance was made in this field, with the discovery in 1927, that the oil soluble sulfonic acid soaps, derived from the treatment of petroleum oils with strong sulfuric acid, were effective rust preventive additives for mineral oils, (3). This early work on the use of petroleum sulfonic acids, ordinarily known as mahogany soaps, was materially improved in 1939 by Lebo, (4) who showed that a mixture of the sodium salts of oil soluble sulfonic acids and degras was superior to either material alone for rust preventive properties.

Succeeding developments in the field of suitable additives for Engine Preservative materials may be classified into the following groups:

Ethers
Esters
Nitrogen Compounds
Phosphorus Compounds
Metallic Soaps
Organic Carboxylic Acids
Miscellaneous

In 1936, Clementson, (5), showed that the acidic products formed during combustion in an internal combustion engine could be neutralized by means of a reaction product obtained by reacting a peroxide of a fixed alkali with an alcohol. The appearance of this reference is probably the first, in which an attempt was made to reduce corrosion in internal combustion engines by means of neutralizing agents added to the mineral lubricating oil.

Of the Ester type materials, the following may be described as those typically used in this field:

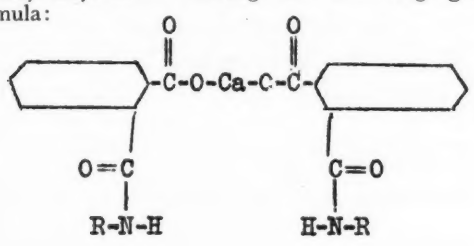
Sorbitanmonooleate (6)
Butyl Stearate
Butyl Naphthenate (7)
Esters derived by the oxidation of petroleum Hydrocarbons, such as petrolatum (8)

Such Esters can either be used by themselves as adjuncts to mineral oil, or in combination with the oil soluble sulfonic acids. Other investigators have used combinations of Esters with the heavy metallic soap of the fatty carboxylic acids, e. g., Roden, (9) found that a combination of aluminum stearate and butyl stearate to be an effective rust preventive additive.

In general, the heavy metallic soaps of fatty carboxylic acids and other types of organic carboxylic acids have been widely used as rust preventive additives in the preparation of Engine Preservative Oils. Magnesium stearate has been used by by Sharp (10). Shields

This fine paper, which was presented at the Second Annual Convention of the A.S.L.E. covers a review of the literature and reports on research investigation made at the Nox-Rust Chemical Corporation in Chicago. Before the war period little was known about the physical and chemical characteristics of preservative oil, but the importance of this subject was greatly emphasized and rapid developments made during the war. This paper summarizes much of the knowledge in this field and includes an extensive bibliography. The use of additives in addition to giving preservative qualities apparently increases oiliness, gives added lubricity, and improves extreme pressure qualities and film strength of the oils treated.

and Bray (8) described the use of the calcium soaps of the carboxylic acids derived from the controlled vapor phase oxidation of petroleum mixtures with petrolatum. Nill (11) has described the use of the carboxylic acid soaps of "sperm" oil acids. These are used in combination with "sperm" anilid, formed by reacting the sperm fatty acids with aniline. A considerable advance in the field of metallic soap type rust preventive additives was made by Smith, Cantrell, and Peters (12-13), who combined into a single molecule the properties of rust prevention and acid neutralization. Their soaps may be described as "metallic derivatives" of phthalyl-alkyl-amides having the following general formula:



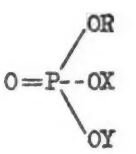
where R represents an alkyl group containing 8 to 20 carbon atoms. They are readily prepared by reacting phthalic anhydrid with lime and primary alkyl amines, most advantageously with amines having the following generic structures:

$$H_2N—CH_2—(CH_2)_n—CH_3$$

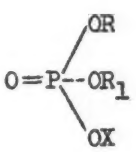
where n is a number between 6 and 18. Typical amines which these authors have used, are mono-capryl amine, mono-lauryl amine, and mono-stearyl amine. In addition to calcium, other metals can be used, such as aluminum (13).

In the field of phosphorus compounds, it was very early shown (14) that various organic phosphorus esters were effective rust preventive additives. These had the following generic formulas:

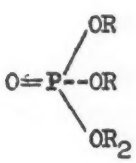
Mono-ester



Di-ester



Tri-ester



where R R_1 and R_2 represent the same or different carbon radicals and X and Y represent hydrogen or salt forming radicals. Typical examples of the products which have been used may be mentioned—di-stearyl phosphate, di-octyl phosphate, mixed phosphate esters of lorol and ocenol, dicylclohexly phosphate, dicresyl phosphate. In addition to the straight alkyl esters of phosphoric acid, the amine salts could also be used,

A.S.L.E. Members

The Fall and Winter season of Section Meetings begins this month. It is the direct responsibility of every member of this Society to contribute to the success of these meetings.

The Section Officers give freely of their time to provide the meeting place and programs of interest.

The various committees meet frequently during the year. This takes time and planning. The National Office is in constant touch with all Sections and acts as a clearing house for speakers and information.

The Journal, which is now appearing bi-monthly, carries technical and practical papers with items of general interest to every one.

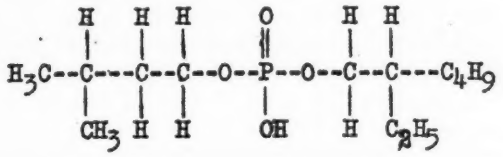
We hope to have many suggestions from the members regarding Sectional and National affairs. We have many problems and we need your help to solve them.

Regular attendance of meetings, discussion of points not clear and volunteering for committee work, will help you and aid the society.

May the Section Officers count on your support for the season of 1947-48.

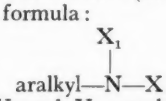
W. F. LEONARD,
Secretary & Treasurer

such as the lauryl-amine salt of dilorol phosphate. Somewhat similar compounds were disclosed by Smith and Cantrell in 1945 (15-16-17). Smith and Cantrell reacted isoamyl octyl acid phosphate



with primary fatty amines containing from 8 to 18 carbon atoms, such as monocapryl amine, mono-lauryl amine and mono-stearyl amine, to form effective rust preventive additives for addition to mineral oils. Similar reaction products derived from aromatics, such as the acid phosphate esters of alkylated phenols with cyclic amines are also disclosed by Smith and Cantrell (18-19). The data presented by these investigators indicate that rust preventive additives of this class impart excellent humidity and salt water immersion protective properties to mineral oils to which they are added.

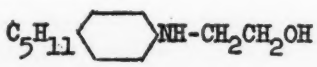
The nitrogen derivatives in the field of rust preventive additives, for the most part, impart the function of acid neutralization to the rust preventive mixtures to which they are added. In some cases they can also possess rust preventive properties by themselves. However, the literature has indicated that they are most effective when used in conjunction with a rust preventive additive of the type of a petroleum sulfonic acid or esters or fatty materials such as common degras. Thus, in 1942, Irwin (20) found that aromatic amines, e. g., di-ethyl phenol amine, markedly improved a rust preventive composition in which lard oil and soluble castor oil were the principal rust preventive additives. Howland and Horst (21) found that compounds of the general formula:



where X and X_1 are hydrogen alkyl or aralkyl, i. e., nitrogeneous compounds containing one or more aralkyl substituents directly linked to an amino nitrogen atom, are effective rust preventive additives when added to mineral oils. Compounds which they found to be particularly effective were monobenzylamine, dibenzylamine and mixtures. Other nitrogen compounds which can be used solely as rust preventive additives are the oil soluble onium bases, identified by the type formula:

$$R_nMX$$

where R_n are hydrocarbon radicals, M is a metaloid or metal onium base element and X represents a negative inorganic group, such as hydroxyl group or a mineral acid anion radical. These were discovered in 1944 by Smyers (22) and typical examples of onium bases which were found to be effective, by him, were dimethyl benzyl cetyl ammonium hydroxide, dimethyl octadecyl benzyl ammonium hydroxide and similar compounds. Anderson (23) found that wax amines, prepared by treating chlorinated wax with ammonia, were effective rust preventive additives for mineral oils. In addition to the free wax amines, Anderson also used the fatty acid salts, such as wax amine salt of stearic acid. Zimmer and Carlson (24) found that the aryl derivatives of mono-ethanol-amine e. g., paratertiry amyl phenyl mono-ethanol-amine



were effective additives for neutralizing hydrobromic acid formed in internal combustion engines. McCleary (25) found that the reaction products of alkylated phenols with formaldehyde and amines forming compounds of the type e. g., octylphenol dimethylamine and formaldehyde, were effective rust preventive additives for mineral oils. Burwell and Camelford (26) produced effective rust preventive additives by forming amino derivatives of the alcohol ketone oxidation products of mineral hydrocarbons, such as petrolatum. Along the same line, Burwell (27) found that combinations of the neutral unsaponifiable products of the oxidation of petroleum with fatty materials, such as tung or linseed oil, formed effective rust preventive compounds for mineral oil additives. Conquest (28) found that mixed aryl-alkyl ketones have rust preventive properties.

One of the most interesting developments in the field of rust preventive additives for mineral oils comprises the discovery that high molecular weight free organic carboxylic acids were effective for this purpose. One of the earliest indications of this was the discovery by Roehner (29) that the free pine fatty acids obtained by the fractional distillation of fatty matter extracted from pine wood in the course of cooking by the alkaline process for the manufacture of wood pulp, were greatly superior to lanolin type compounds as additives to mineral oils to improve their rust preventive properties. Moser (30) found that the addition to lubricants of high molecular weight polycarboxylic acids resulted in an appreciably reduced attack of the piston and the cylinder walls through rust formation in aero engines. The poly-carboxylic acids used by Moser were obtained by a condensation reaction of olefins with maleic acid and anhydride, the olefins being formed, e. g., by cracking paraffin wax at high temperature. Following Moser's disclosure, a whole group of organic carboxylic acid derivatives have been disclosed in the literature as being effective rust preventive additives for lubricating oils. Thus, Larsen (31) found that by sulfurization of the Moser (30) products, an additional improvement in rust preventive potency was obtained. Other compounds in this group are alkyl acid phthalates, Werntz (32), condensation products of maleic acid and rosin acids, Jahn (33), dicarboxylic acids, in which the carboxylic acid radicals are linked through trivalent Nitrogen, such as the N-amino alpha--alpha- di-fatty acids, White (34), mercapto-monocarboxylic acids, such as alpha mercapto stearic acid, White (35-36-37), N-amino dicarboxylic acids, such as toluidine di-alpha stearic acid, ether-dicarboxylic acids, such as alpha (2-carboxylic phenoxy) alpha stearic acid of the structure

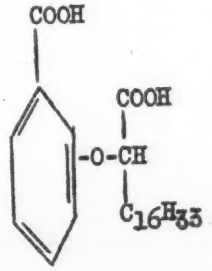


TABLE VI

Engine Test Requirements
AN-VC-C-576—50 Hours Endurance Test

1. A new Wright R-1820 engine No. SW-033396 is disassembled for inspection. The engine, if found satisfactory, is reassembled and placed on an outdoor test stand.

2. The engine is then given the following shake-down run with oil conforming to Specification AN-VV-O-446, Grade 1120:

Time (Min.)	RPM	M. P.
15	900	
15	1200	
15	1500	17.5
15	2000	32.2

At the completion of the run the oil is drained, the filter is checked, and compounded oil consisting of 25% of Engine Preservative oil type additive and 75% of oil conforming to Specification AN-VV-O-446, Grade 1120 is placed in the engine.

3. The fifty-hour engine endurance test is conducted as follows:

a. Twelve and one-half hours at normal rated power and speed (1000 H.P. at 2300 RPM), and twelve and one-half hours at 2000 RPM and 31 inches of Hg. manifold pressure (maximum cruise RPM and power) at 0.060 and 0.065 fuel air ratio.

b. Ten hours of alternate periods of five minutes take-off (1200 H.P. at 2500 RPM), and five minutes at as low an idling speed as possible.

c. Ten hours of alternate periods of 15 minutes military power (1200 H.P. at 2500 RPM) and 15 minutes at 1400 RPM with same propeller pitch.

d. Five hours at rated power and overspeed (1000 H.P. at 2530 RPM).

e. Thirty dives of 30 seconds plus or minus 3 seconds duration each at 2760 RPM and as low a manifold pressure as possible.

The oil mixture is not drained from the engine from the time the engine started until completion of the endurance run. The oil mixture is added as required during the test.

4. At the completion of the above endurance run, the engine is removed from the test stand and completely disassembled for inspection.

and similar compounds, in which the ether oxygen can be replaced by sulphur, Barnum (38-39-40), Zublin (41).

Protection Tests

In the physical testing of Engine Preservative materials, the humidity cabinet forms an important piece of equipment for their evaluation. The humidity cabinet is a piece of equipment designed to produce 100% relative humidity at a selected temperature of 100° or 120° F. In general, it will vary from laboratory to laboratory, however, some attempt at standardization has been tried by describing exact types of equipment and these are given in the various specifications referred to. It measures the protective ability of the Engine Preservative material against high relative humidity and condensation cycles. In the investigation of Engine Preservative oils, it is desirable for the purpose of evaluation, to run the humidity tests beyond the limits demanded by the specification. Further, in order to take care of the eccentricities inherent in such types of test equipment, it is also desirable to run duplicate determinations at different spaces in the same cabinet and to repeat the tests in different cabinets, and at the same time, to compare the sample under investigation with standard samples, if such are available. In this manner the comparative results of the piece of research work can readily be set up and evaluated.

Since the oil soluble soaps of petroleum sulfonic acids differ considerably in quality, depending upon the type of crude from which they are derived, the humidity cabinet can be used as an instrument for selecting the proper classes of mahogany soaps to be used in the formulation of suitable Engine Preservative materials. It is recommended that reference formulations be used which will stand up very well under severe testing conditions. Possibly two formulations should be used for this evaluation purpose. Formulations are then made up in which everything is kept constant except the composition of the sulfonic acid. When the formulations are made up, at least eight panels shall be used for the evaluation work for each formulation, having four polished steel and four sandblasted steel panels, (2x3x⅛" SAE 1020 Steel) using two of each kind in a humidity cabinet maintained at 100° F., and two of each kind in a humidity cabinet maintained at 120° F. It is also recommended that secondary references be used in which all other factors are maintained constant except that the petroleum sulfonic acid is omitted. The test is conducted until definite failure is evident also on the reference formulations. At this point the experiment is concluded, the panels are taken

Each Number Represents the Mean of Two Panels

TABLE VII

Evaluation Test of Various Mineral Sulfonates **

Formulation I			Sulfonate a.		Sulfonate b.		Sulfonate c.		Sulfonate d.		Sulfonate e.		Sulfonate f.		Sulfonate g.	
		(Days Exposed)	(5)	(14)	(5)	(14)	(5)	(14)	(5)	(14)	(5)	(14)	(5)	(14)	(5)	(14)
100% Relative Humidity 100°F.		Polished Plates	0.0	0.02	0.0	0.04	0.0	0.0	0.0	0.2	0.0	0.3	0.0	1.4	0.0	0.1
		Sandblasted Plates	0.0	0.0	0.0	0.0	0.2	4.8	0.02	1.0	0.02	1.2	0.2	6.0	0.0	0.0
	100% Relative Humidity 120°F.	Polished Plates	0.0	0.0	0.0	0.01	0.0	0.4	0.0	0.5	0.0	0.0	.57	2.6	0.0	0.0
		Sandblasted Plates	0.03	1.4	0.0	0.0	0.4	1.0	0.0	0.0	0.02	0.6	0.0	3.0	0.0	1.4
Mean			0.35		0.01		1.55		0.42		0.57		3.25		0.37	
Formulation II																
100% Relative Humidity 100°F.		Polished Plates	0.0	0.0	0.0	0.0	0.0	.02	0.01	0.3	0.0	.01	0.0	0.0	0.0	1.4
		Sandblasted Plates	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0
	100% Relative Humidity 120°F.	Polished Plates	0.04	0.0	0.01	1.6	0.0	0.0	0.0	0.2	0.0	0.0	0.01	0.0	0.0	0.0
		Sandblasted Plates	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.4	0.0	2.6	0.0	0.0
Mean			0.0		0.4		0.10		0.12		0.10		0.65		0.0	0.85
Total Mean			0.17		0.20		0.82		0.27		0.35		1.95		0.61	
Rating of Sulphonate			Best		2nd		6th		3rd		4th		Worst		5th	

SAE
* X 1020 Steel 2 x 3 x 1/8"
** .no rating scale based on 0 for no rust whatsoever to 10 for a completely rusted plate.

out of humidity cabinets, washed in hot mineral spirits and dried and laid out on a laboratory bench for evaluation. Table VII summarizes typical results obtained. The panels are rated according to the amount of rust present, using an arbitrary scale with 0 for no rust whatsoever and 10 for 100% rust. The rust evident on the panels of one type material is arithmetically expressed as a mean and the means derived from the various formulations give the relative protective value of the sulfonates, because all other components are maintained constant.

There are three typical Government specifications dealing with engine preservatives. They are: U. S. Army 2-126 for oils ready for use—SAE and SAE 30 grade; Army-Navy Aeronautical Specification AN-VV-C-576 for oil type Base Material to be blended with 1120 or 1110 aviation grade oil, and Bureau of Ships 52-C-18 grade 2, for semi-solid film-forming Base Material compounded in a solvent vehicle. In further description, reference is made to the specification numbers only. See table I, II, III, IV on page 45.

A special type of humidity test of unusually severe character is required of the oil type additive materials described in the Army-Navy Aeronautical Specification AN-VV-C-576. This is the so-called "tropical room" test and is meant to simulate the crated shipments of aircraft engines to tropical climates. In this test, a fully crated aircraft engine, which has been treated with the oil type additive material blended to three parts of an 1100 or 1120 grade aviation oil, is placed in a thermostatically controlled humidity chamber, which is cycled over a rather wide temperature range, the humidity being maintained at 100% with condensation occurring continually. This cycle is carried out over a period of 24 hours for several days, after which time the engine is removed from the crate, disassembled and examined for conditions of rusting.

The hydrobromic acid neutralization test is of real significance in that it is designed to measure the pro-

tective values of the Engine Preservative materials against the formation of hydrobromic acid due to the presence of ethylene bromide in leaded fuels. These tests are generally carried out as follows:

A steel panel is exposed to hydrobromic acid and is placed immediately into the Engine Preservative material, the duration of the hydrobromic acid action on the panel varying between the three specifications, but they all have in common that the neutralizing action of the Engine Preservateive material is limited to one minute. The panel is then withdrawn from the Engine Preservative material and left in the laboratory for four hours in Specification 2-126 and 52-C-18, while in the AN-VV-C-576, the procedure is still more severe because the panels, after treatment with the hydrobromic acid, are conditioned in the laboratory for two hours and then exposed in the humidity cabinet at 120° F. for twenty-four hours. Practically no rust shall be evident on any of the panels after the specified time. 2-126 and AN-VV-C-576 use sandblasted panels, 52-C-18 Grade II requires the use of polished I square inch steel discs. The strength of the hydrobromic acid is .1% in 2-126 and 52-C-18, Grade II, and it is .2% in AN-VV-C-576, but in this specification it has to be emulsified with 90% 1120 Grade mineral oil.

The salt spray and salt water immersion tests measuse the protective qualities of the Engine Preservative materials against exposure to salt fog and contact with sea water. The salt water immersion test is carried out in a synthetic sea water, prepared as follows:

Using chemicals meeting ACS standards for reagent chemicals,

Magnesium chloride, hexadydrate
11.0 grams per liter of solution

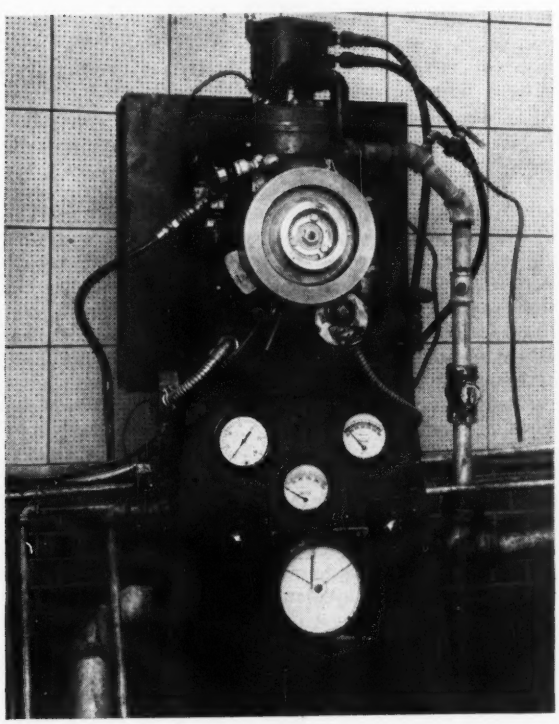


Figure No. 1

Lauson Engine Model H-2 Used in Armour Research Foundation Project 1-410F

Anhydrous calcium chloride
1.2 grams per liter of solution
Anhydrous sodium sulfate
4.0 grams per liter of solution
Sodium chloride
25.0 grams per liter of solution.

The solution brought to a pH value of 8.0 to 8.2 with a 5% addition of sodium carbonate. Sandblasted panels are tested in the Engine Preservative material and conditioned in the laboratory for sixteen hours, then placed in the salt solution in individual beakers, fully covered, for a period of twenty hours. After this time, the panels are washed free of salt water, the oil film is removed by petroleum solvents and the dry panel examined for corrosion. While 2-126 and AN-VV-C-576 deal with mineral oils, the 52-C-18b, Grade II, forms a semi-hard, waxy film on the panel which comprises the rust preventive base material itself. It is, exposed to a more severe protection test, as before mentioned. This is the salt spray exposure test in which panels are subjected to a 4% sodium chloride fog at a temperature and 100° F. for a period of fourteen days.

Such tests as flash points, viscosity, pour points, ash, Conradson Carbon and foaming will not be discussed in the present paper. Most of these tests are those required in general for the preparation of 2-104 oils.

The effect on "color-indicating" properties of cobalt chloride-impregnated silica gel dehydrating agent, as required by AN-VV-C-576, is designed merely to determine whether the oil type additives, designed under the specification, have any effect on such indicators, dehydrating agents, as they are normally used in the packaging of aviation engines.

As the Film Forming Additive Type of preservative materials is more particularly designed for extensive storage, the specification requires a semi-practical shed storage test. This is conducted by treating steel cylinders with the material under test, and then suspending in a covered box over a pan of salt water in order to accelerate the test. The box, meant to simulate a shed, is open at the bottom and slanted downward to prevent ingress of rain or snow. The test simulates material placed in shed storage or under canvas and where the protected specimens are not in contact with the direct rays of the sun. The exposure is carried out for a period of one hundred and twenty days.

Engine Tests

The ultimate approval of Engine Preservative materials is based upon actual engine tests. All of the previous tests described measure the protective qualities of the Engine Preservative materials under static conditions, e.g., it is quite possible that a rust preventive material which will serve very well under static conditions, such as storage conditions, would age and sludge when exposed to high temperatures when used under actual engine operating conditions. This would cause ring sticking, the formation of deposits and sludges, which would make the operation of the engine entirely unsatisfactory, if not impossible. Only an actual engine test is sufficient to tell whether the intent of Specifications 2-126 AN-VV-C-576 and 52-C-18b, Grade II, can be carried out, i.e., whether the Engine Preservative material will also be good enough for use in an internal combustion engine during operation. The results of the engine test will give evidence of any corrosion, ring sticking, deposits or sludging that might have occurred during the test. Obviously, while this method is labori-

ous and expensive, it is still far more economical than putting a product on the market without such a test, involving as it does, the danger of engine failure under actual operation conditions. (49) A very excellent survey of evaluation methods for crankcase oils and internal combustion engines has been presented by Penfold and Petry (42). The conditions for these tests are summarized in Tables V and VI. The Chevrolet Engine test, summarized in Table V and described in Army Ordnance Specification AXS-1554, is designed to measure the stability or resistance to oxidation, the resistance to bearing corrosion and the prevention of the Engine Preservative material formulated under Specification 2-126. It will be noted that the procedure involves the intermittent operation of a special six-cylinder automotive-type test engine at constant speed and load for a total of thirty-six hours, subsequent to a run-in period of eight hours at graduated speeds and loads. The performance of the test oil is judged by examination of the power section for deposits, by ascertaining the weight loss of the test bearings and by inspection of the new oil and of samples of used oils taken near the middle and at the end of the test.

It will be evident from an examination of Table VI, which summarizes the test conditions for the "50-hour engine test" for the oil type additives designed to meet Specification AN-VV-C-576, that it is meant to simulate actual flight.

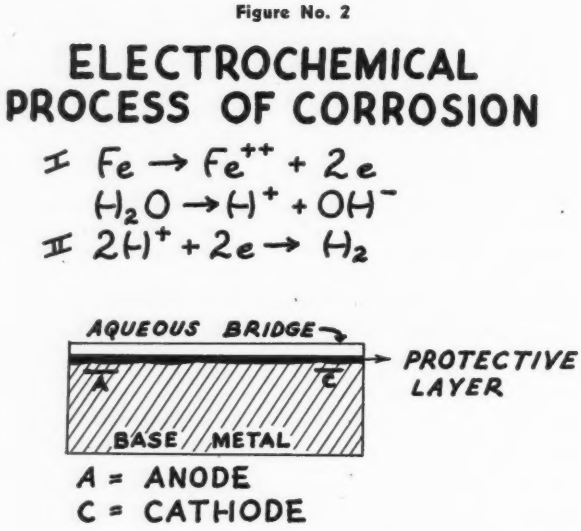
In the evaluation of Engine Preservative materials, it is desirable to have available laboratory tests to enable one to select materials for final engine testing. Since engine tests are expensive, this preliminary screening is essential to select the materials which have the best chance of passing the engine test.

In preliminary evaluation work, the Underwood Tester and the one cylinder Lauson Engine Model H-2, Figure No. 1, are generally used as screening tools. The procedure followed in an Underwood Tester is uniform among the various laboratories by keeping the oil temperature at 325°F., the oil pressure at 10 pounds and the duration of the test 10 hours. As for the Lauson Engine test, no standard procedure exists so far. Reference is made, at this place, to a paper of H. O. Mougey and J. A. Moller (47) on Heavy Duty Motor Oils, and also to a report by H. L. Hemmingway (48) at the May, 1944 meeting of the Society of Automotive Engineers on Fuels and Lubrication Division in Chicago. Both papers refer to a cooperative research program carried out between the Armour Research Foundation and a number of research laboratories, on comparative Chevrolet Engine and Lauson Engine tests. In the work just referred to, no definite correlation was obtained as to piston varnish rating in the Lauson and Chevrolet engine test. At this place we want to mention a cooperative research program now in progress between our laboratory and the Armour Research Foundation. Results of this project, which seeks to obtain better correlation between the Lauson Engine Model H-2 and Chevrolet Engine test for piston varnish ratings, now reported in the literature, will be published later on. (50)

Theoretical Aspects

The electrochemical theory is accepted today as the best means of explaining the various forms of corrosion which occur. The electrochemical process of corrosion is a condition under which a metal goes into solution in an ionic condition with the displacement of less electropositive ions from the solution. When iron rusts, various ions go into solution at some point or points, and by so doing, displace hydrogen from the solution. The theoretical concept is summarized in Figure No. 2. The hydrogen gas escapes, leaving behind an excess of hyroxyl ions which makes the system alkaline. The basis for the whole process, of course, is in the potential, which is associated between the point of solution and the point of displacement. In fact, the most common characteristic phenomenon of corrosion is its tendency to localize. Corrosion has a tendency to roughen surfaces due to the fact that pitting has taken place locally at many points on the surface due to the electrolytic effect. The electrical action which is most commonly understood, is the galvanic effect due to the presence in electrical contact of two metals of different tendency to go into solution. This occurs by differences in composition of the metal, physical non-homegeneity of a single piece of metal or by electrical contact between two entirely different metals.

Figure No. 2



Depending on the severity of exposure conditions, Engine Preservative materials will protect exposed metallic surfaces for periods of several months to a few years. As indicated in the previous discussion, in order to facilitate the testing of Engine Preservative materials, relatively high temperatures and humidities are used under controlled conditions. It is noted, under such tests, that mineral oils containing no rust preventive additives, allow rusting in a few hours, whereas, Engine Preservative materials containing rust preventive additives, protect the steel specimens for many hundreds of hours. Accordingly, the effects obtained are due to the presence, in the mineral oil, of these rust preventive additives, and the theoretical concepts are based upon the behavior of these molecules in a dynamic system composed of water, oil film and metal. A review of the combinations which have proven effective as rust preventive additives presented in our discussion above, may all be classified under the term "polar" compounds, that is to say, they comprise molecules which are very strongly electrically unbalanced and in general are composed of the structure which might be presented under the general formula:

A-B

where A is usually a very heavy inert radical and B is a very small highly electro polar component. These molecules very strongly intend to orient themselves in depending upon the type of environmental system in which they occur. The simplest illustration of this is

that of a soap consisting of a long hydrocarbon chain and a polar end-group at an oil-water interface. The polar group will be oriented throughout towards the water and the hyprocarbon chain will tend to point towards the oil. In an oil-metal interface, the polar organic additives are oriented in such a way as to set up a barrier to the normal mode of entry of the agents causing corrosion, namely, oxygen and water. This, in effect, might be termed a mechanical theory of rust preventive action. However, it is also possible, depending upon the composition of the rust preventive additives, that inhibitive and galvanic protection might also be contributing factors. These will be discussed. One of the first scientific studies to determine the mechanisms of rust preventive action in oil films was conducted by Pilz and Farley (51) who studied the contact angles formed by the dynamic system composed of water and oil film and metal. Their findings were in agreement with the theory of rust preventives which postulates that the additives are strongly oriented at the oil-metal interface, forming a protective barrier against entrance of corrosive elements. The orientation of polar compounds in mineral oils against metallic surfaces has also been previously studied, Karplus (43) and Trillat (44) showed that when an oil solution of oleic acid and mineral oil was brought in contact with iron or steel, orientation of the polar compound on the metal surface occurred. This orientation consists in a concentration of the polar compound at the oil-metal interface and the deposition of orderly aligned molecules. The polar group of each molecule of the first layer is aligned at the metal surface by absorbtive forces and the non-polar residue, i.e., the alkyl group of oleic acids, extends outward from the metal surface. According to these investigators the forces of orientation of the random polar molecules extended over a distance of 9,000 Angstrom units and lead to the formation of multimolecular oriented layers similar to those described by Langmuir (45) and by other investigators (46). The literature, accordingly, indicates that metals exert an especially strong attractive influence towards polar compounds. Pilz and Farley (51) have postulated that between these oriented layers of the polar molecules in solution, there is established an absorption-desorption equilibrium. These oriented layers serve to prevent rusting of the metal by interrupting the normal mode of entry of water and oxygen. They believe that their explanation is sufficient to account for the fact that the amount of additive actually required in service for adequate rust prevention is greatly in excess of that needed to form an oriented layer on the metal surface. Although such a layer may be sufficient to prevent rusting, they theorize that further increment of anti-rust agents are instrumental in shifting this equilibrium in favor of further absorption and maintaining it until the additive has been depleted to the extent that the desorption-absorption equilibrium is reversed. When desorption becomes extensive, the oil film no longer remains impervious to water and oxygen, and rusting results. Because of the water soluble nature of certain polar rust preventive additives, Pilz and Farley (51) believe that the mechanism by which rusting occurs in an oil protected metal surface, is due to the depletion of the rust preventive additive by the continual leaching action of the water condensing on the surface. This refers to accelerated testing in the humidity cabinet. However, they do concede that rust preventive additives are possible in which the orientation at the water-oil and oil-metal interface are considerably different, i.e., compounds whose polarity towards metal are considerably stronger than their polarity towards water. Another possibility exists in which combinations of polar rust preventive additives can be made which will alter the orientation of these additives to water-oil interface so that inversion of emulsion which ordinarily occur with highly water soluble types can take place, that is to say, combinations of rust preventive additives of different polarity are possible which would change an oil-in-water emulsion to water-in-oil type. It is believed that, at the same time, a strong water repellent thin film is formed on the metal surface itself. Under such conditions, the appearance of corrosion would be more likely due to a rupture of the oil film which bares the metal surface, allowing contact to be made between water and steel and removing all protection media from a localized area.

The simplest picture that can be presented for the mechanism of rust preventive additives in mineral oil is that of a mechanical barrier which depends upon the isolation of the metal from the exposure environment and upon the ability of the coating to insulate the anodic and cathodic areas from the aqueous bridge which is necessary for electrolytic corrosion to occur. The strong forces of absorption indicated by various investigators for polar orientation at metal-oil interface could possibly be responsible for such mechanical protection if it exists. In other words, the bind of the polar groups to the metal surface is so strong that there is no area available on the metal surface for oxygen and water, the causative agents of rusting. We cannot, however, exclude from consideration, purely inhibitive and galvanic mechanisms of protection induced by rust preventive additives of the polar type. The inhibiting mechanisms may be described as a type of effect in which the metallic surface becomes passive or inactive towards environments in which they will normally corrode, owing to the formation of self-healing protective films. The most common examples of this type are the inclusion of such inhibitive materials as lead, zinc and chromate type compounds which inhibit the process of corrosion by essentially functioning as oxidizing agents at the metal-oil film interface. A mechanism of this type does not preclude the entry of water into the metal-oil interface, since in many cases, these inhibiting rust preventive additives depend upon the availablity of a limited amount of moisture in order that the ions responsible for producing "passivation" may reach the metal surface. One final mechanism which must be considered, and which undoubtedly can account for the rust preventive action of certain metallo-organic type additives, is the protection afforded by electrochemical or galvanic action to the base material, e.g., such a metal as zinc, is sacrificial to steel or to iron in that it dissolves or corrodes in preference to the ferrous metal, thus making the iron a cathode. It is possible that such rust preventive additives form a sort of alloy combination at the metal-oil interface offering a more electropositive surface to the base material.

Summary

1. The visible and invisible factors of corrosion are defined which might be manifest in an Engine during storage, shipment and operation.
2. Three methods are given for utilizing Engine Preservative materials.
   a. Oils ready for use.
   b. Oil type additive base.
   c. Film forming type additive base.
3. Requirements and testing methods are discussed in detail, also reference is made to existing correlative test

(*Continued on page* 42)

Walter D. Hodson

1870 - 1947

THE American Society of Lubrication Engineers still mourns the tragic death of Walter D. Hodson. Mr. Hodson was riding in the plane which crashed in the Blue Ridge mountains near Washington and died instantly on June 13, 1947.

It was characteristic of Mr. Hodson that he was vigorously at his occupation up to the very time of his death. Those of us who have known him over many years feel that in some ways he might have wished a sudden end instead of a lingering illness.

Mr. Hodson was born in 1870 on the site of the present Dearborn Street Station in Chicago. He is survived by one daughter and his three sons — Lee, Walter and Elliott — and by his wife, Carra Brooks Hodson. In 1924 he founded the Hodson Corporation which has grown at a significant rate under his guidance.

His interest in the lubrication industry led him to devote an enormous amount of his time and effort to furthering progress in this field, and it was almost completely through his individual efforts that the American Society of Lubrication Engineers came into existence. Although he had assistance from many who enjoyed working with him, his own part in the organization cannot be over-estimated. It was on his invitation that the organizational meeting of the Society was held in Pittsburgh in September of 1944, and from this meeting grew the virile organization which is continuing its rapid expansion. During the first year or so of the Society's life, he was the guiding genius who kept the new officers continuously inspired to greater efforts.

Although the American Society of Lubrication Engineers was Mr. Hodson's first love among technical societies, he was also associated with the American Society of Mechanical Engineers, the American Institute of Steel Engineers, the American Society of Testing Materials and several others. He was a splendid host and was a member of many social clubs including the Union League and South Shore Country Clubs of Chicago and the Pittsburgh Athletic and New York Athletic Clubs outside of the city.

Mr. Hodson's memory was honored at a Memorial Service held on June 18, 1947, in Chicago. His many friends sincerely mourn his passing.

"The good deeds a man does live after him."

NEW BOOKS, BULLETINS and MANUALS

New Literature

The Apex Alkali Products Company, Philadelphia 27, Pennsylvania. Complete data is given on TUBE DRAWING COMPOUNDS, telling how the important objectives of greater die life, increased speed and improved finish may be achieved. CLEANING COMPOUNDS and DEEP DRAWING and STAMPING COMPOUNDS — presented with experienced data. The whole information is put up in the form of a very interestingly written booklet.

CONCISE CHEMICAL AND TECHNICAL DICTIONARY—

Edited by H. Bennett.

Chemical Publishing Company, Inc., New York—1947. 1,055 pages. Price, $10.00.

This dictionary of chemistry, science and technology is new. It contains definitions and information about newly developed synthetic chemicals, processes and appartus with a large number of new terms carefully defined.

In addition to the standard technical names, there are listed many trade names of proprietary products in the synthetic resin, plastic, metal, rubber, textile, food, pharmaceutical, paint and varnish fields.

The use of bold face and standard type on attractive pages leads to ease of finding material being sought.

POWDER METALLURGY—

By Henry M. Hausner.

Chemical Publishing Company, Inc., New York—1947—307 pages. Price, $7.00.

This book discusses the principles of Powder Metallurgy in detailed form starting off with a glossary of terminology and developing the fundamental principles involved.

A large amount of data are given on the characteristics of metal powders and data on the compacting pressure and physical properties of the products which can be made.

The book is replete with tables and diagrams and a very extensive bibliography covering 1064 references follows the textual matter.

Copies of it will certainly find their way into the libraries of all interested in this important and relatively new field of metallurgy.

STEAM TRAPPING AND AIR VENTING—

By G. Northcroft.

Chemical Publishing Company, Inc., New York—1946. 172 pages. Price, $4.50.

This book covers in detail proper methods of steam trapping and air venting. Stress is laid on the importance of correct methods of condensate drainage. Detailed descriptions apply for many of the common types of traps and air-vent devices.

The material is presented from an elementary viewpoint and can readily be understood by one whose acquaintance with the field is not extensive.

Both American and British equipment are covered in the text, and many of the examples are illustrated from English practice.

MODERN POLISHES AND SPECIALTIES—

By W. D. John.

Chemical Publishing Company, Inc., New York—1947. 313 pages, Price, $7.50.

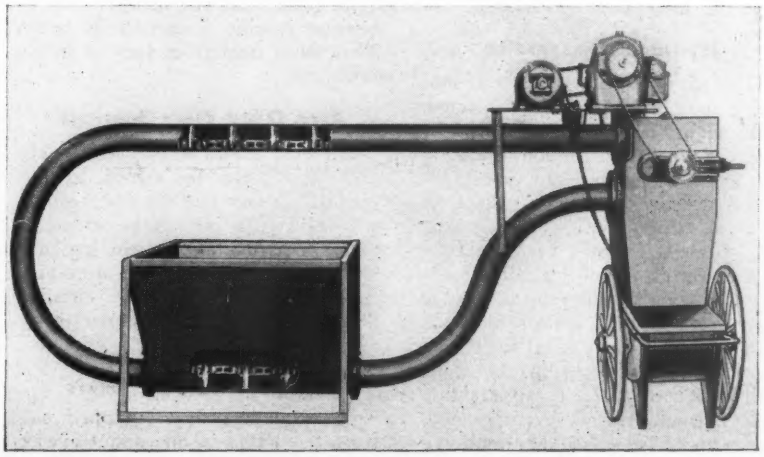
For those people interested in the manufacture of chemical preparations, this book is indeed invaluable. It is replete with numerous formulae for polishes, waxes, sweeping compounds, leather restorers, leather dressings, metal and paint polishes and cleaners, as well as many miscellaneous materials.

The preparations are not only considered from a quantitative viewpoint, but detailed descriptions as to how the mixtures are prepared are also given.

B. H. Jennings.

HELP WANTED. Nationally known, well established manufacturer of lubricating equipment, wants to employ a lubrication engineer who can give technical assistance to our customers in selection of lubricants and methods of application and can demonstrate and explain equipment at shows, technical society meetings, etc. Give age, education, experience, salary expected, and enclose photo in first letter. **Address Box 333, Lubrication Engineering, 343 South Dearborn Street, Chicago, Illinois.**

The Honan-Crane Company are featuring their Houdaille Conveyor (for sludge and chips) for automatic removal of sediment. The conveyor employs heavy link chain with 4″ neoprene rubber flights to operate in endless chain fashion, through the V-bottom of the tank, and through a 4″ pipe line to a sludge hopper or collector for disposal. Also the "T" type clarifier direct connected to single machines or in multiples which will handle an entire department. This clarifier employs a woven fibre and metal screen for filtering media. Screen mesh size provided to specifications.



LUBE SPOTS

Here is the new feature page which will appear each month and will contain remarks on lubrication problems, by competent authorities, answers to questions submitted and publication of various facts and data pertaining to practical application in the plant. We solicit your communications which should be addressed to the office of LUBRICATION ENGINEERING, 343 South Dearborn Street, Chicago 4, Illinois. We have had requests for information on the following subjects and the following short comments are from qualified lubrication engineers.

Coupling Lubrication

Because the centrifuging action of couplings tends to separate the oil and soap which are found in most greases special care in the selection of lubricants is advised. Due to variation in design and speed and H. P. requirements, no single lubricant can be recommended as universally satisfactory. Manufacturers' recommendations should be carefully followed. If the installation is unconventional and might be in contact with water or unusual temperatures, either high or low, consultation with the technical department of your oil supplier is recommended. Care increases life. In general, coupling lubrication has been neglected. There are satisfactory lubricants now on the market to provide proper lubrication under all conditions of operation. A 75-100 H. P. coupling is expensive and lubrication failure means a major shutdown. Six months periodic inspection is advised.

Hydraulic Reservoirs

The hydraulic systems on machine tools are as a rule neglected. All such equipment should be checked monthly for oil leaks in screw joints, flanges and pipes. Inspection plates left open admit all sorts of contamination, particularly on grinders. Where the hydraulic system furnishes lubrication for the ways, particular care must be used to stop contamination from soluble oil, chips, etc. Viscosity of oil to be used should be determined by the make and design of the circulating pump and manufacturer's recommendations should be followed. If running two shifts, reservoirs should be drained, cleaned and refilled at six-month intervals. In general, this oil can be re-filtered and re-used. Oils containing additives should be treated in filters containing an inert filter medium. Careful attention to these details will give you smoother operation of all machine tools so equipped.

Lubrication of Electric Motor Bearings

Grease-lubricated anti-friction bearings where seals are in good condition or retainers are provided, give very little trouble and have a small loss of lubricant. Cleaned with a solvent, flushed and dried and repacked with fresh grease when the motor is taken down for annual inspection, is about the only lubrication required. The bearings should never be packed full of grease. If the bearing cavity is filled completely, the churning action causes heat. The grease expands and builds up a pressure that is sufficient to burst the seals. The lubricant is lost and the bearing fails. When grease applications are made with a pressure gun, remember that you are using an average pressure of 3500 PSI. One stroke of the lever over the right amount can blow out the seals. Pressure release fittings can be installed. They are similar in appearance to regular fittings but they have a milled slot that opens only from inside pressure in the bearing cavity, allowing surplus grease to "bleed off." These fittings are inexpensive and good seal insurance. More bearing trouble is caused by over-lubrication than from lack of lubricants.

Ring Oiled Plain Bearings

Oil level should be checked weekly and oil should be added to the "point." Never add oil when motor is revolving, as oil will be added in excess of correct level, running into motor, causing damage to windings, with a danger of short circuits. Drain, flush and refill about every 12 months.

Motors with Felt Oilers

Small motors thus equipped call for a few drops of oil (about five or six) every month. Yearly cleaning or replacing felt pads or wicking will insure a free flow of oil to the bearings.

Generally speaking, motors with permanently sealed bearings should be dismantled after about two years of operation, bearings thoroughly cleaned and hand packed with recommended grease. Care should be taken not to overload.

Wick Feeds and Pads

Wick feed oilers are an ideal lubricating device because they deliver oil with certainty, and in amounts closely regulated.

They require so little attention from the operator that they are often neglected completely.

All wick feed oilers, felt pads, or felt rollers used for lubrication are similar in that they make use of the absorbent or capillary power of some porous metal to feed oil slowly and regularly to bearings. However, even under clean conditions some foreign material will find its way into the oil reservoir, so that wicks or pads will eventually clog up and require cleaning. Clogged wicks will restrict the amount of oil feed and may even reduce the feed to the oil where a bearing failure can occur, due to insufficient lubrication.

To maintain the wicks or felt pads properly, they should be washed once or twice a year, or oftener if located in a particularly dirty spot. They should be thoroughly rinsed in naphtha to remove all accumulated deposits. They should then be dried thoroughly. Before replacing them they should be saturated with the same grade of oil that will be used in the reservoir in which they are to be stored.

When replacing, be sure that the delivery end of the wick or pad is at a lower level than the lowest point of the oil reservoir in order to assure proper feeding of the oil.

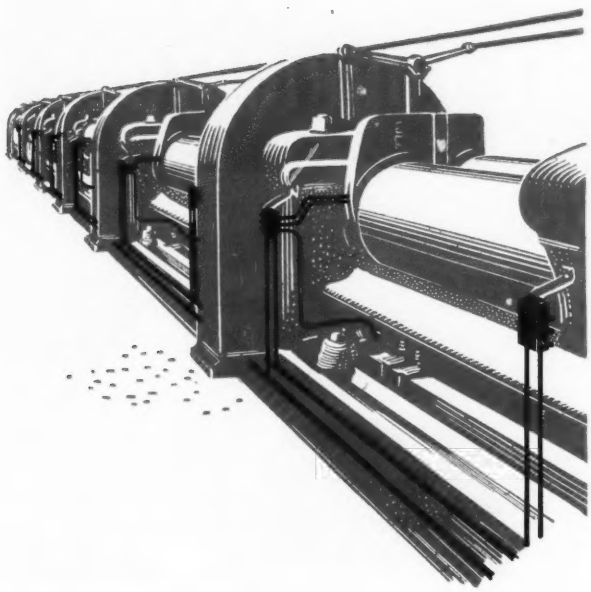
Incidentally, any deposits should be removed from the bottom of the oil cup or well; at the same time new clean oil should be installed.

SEND IN YOUR IDEAS
For Publication on this page
Questions, Remarks and Suggestions

Savings of $1910 a month

from $7500 invested in Farval

FARVAL—*Studies in Centralized Lubrication No. 83*



FOR 12 years, one of the large rubber companies has been enjoying the satisfaction and economy of Farval centralized lubrication on its 46 rubber mills. Formerly, bearings were lubricated with heavy cylinder oil through sight-feed cups. This work, done by hand, took eight oilers and cost $1400 a month. Farval now does the job for $400 a month. The eight oilers were cut to two, who also keep the Farval systems filled and operating around the clock.

The money savings in labor and lubricant average $1910 a month. Yet gratifying as these dollar savings are, this user says the elimination of the former mill delays due to hot bearings has given the company an even larger return in increased mill output—far more valuable than all other economies combined. All this from an original investment in Farval centralized lubricating systems of less than $7500!

Farval delivers oil or grease under pressure to a group of bearings from one central station, in exact quantities, as often as desired. Farval —the Dualine System with the Positive Piston Displacement Valve—that has but 2 Moving Parts—is Fully Adjustable—and with a Tell-tale indicator at each bearing to show the job is done.

Savings comparable to the above can be made on your equipment with Farval. Write for Bulletin 25. The Farval Corporation, 3267 East 80th Street, Cleveland 4, Ohio.

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Machine Tool Show

As we go to press, machinery is pouring into the mammoth Dodge Chicago Plant located in the west portion of Chicago, and since August 4 there has been a constant procession of machinery of all sizes, types and styles. The immense task of moving in all of this equipment has been carefully organized and the exhibits are rapidly taking shape. We feel that the National Machine Tool Builders' Association should be highly complimented for their orzanization of this great task.

The two thousand machines on display will show the entire range of more than 200 different types produced by machine tool builders.

Registrations have come in in large numbers throughout the United States and practically all of the foreign countries. The theme of the Show is "More Goods for More People at Lower Cost." The machine tools that will be shown are truly the master tools of industry which will enable us to produce more and better things for more people.

The Dodge-Chicago Plant is the only factory building in the world large enough to hold an exhibit of such magnitude. Machine tools, equipment and appliances will be shown in actual operation.

LUBRICATION ENGINEERING unhesitantly recommends that any of our members in the vicinity of Chicago during the period of September 16 to 27, avail themselves of this great opportunity to view the latest mechanical developments.

Running concurrently with the Show will be held the Machine Tool Congress. Papers and discussions will be presented on the latest developments in the metal-working industry, at the nightly sessions. Mr. K. H. Hobbie, past President of the Chicago Technical Societies Council, is president of the Machine Tool Congress. Nine important technical associations will participate in arranging the program of speakers at the meetings which will be open to registered visitors at the Show. A series of dinners has been arranged with such noted speakers as:

Charles F. Kettering,
Research Consultant for General Motors Corporation
Industrialist James F. Lincoln,
Pres. Lincoln Electric Company
News Commentator Fulton Lewis, Jr.

who are among the thirteen widely recognized speakers who will address the Congress.

In another column we referred to the Technical Societies Council in conjunction with the program. Inas much as the A.S.L.E. is affiliated with the Council, this program should be of especial interest to all Society members. Dr. Gustave Egloff, president of the Council and Director of Research, Universal Oil Products, will preside.

Grafo Colloids Corp.

The Grafo Colloids Corporation announce two new products of very recent development: a semi-permanent plug valve lubricant, and a die lubricant for die casting of brass. They report that both products are giving excellent results.

A FEW OF THE MANY USES FOR

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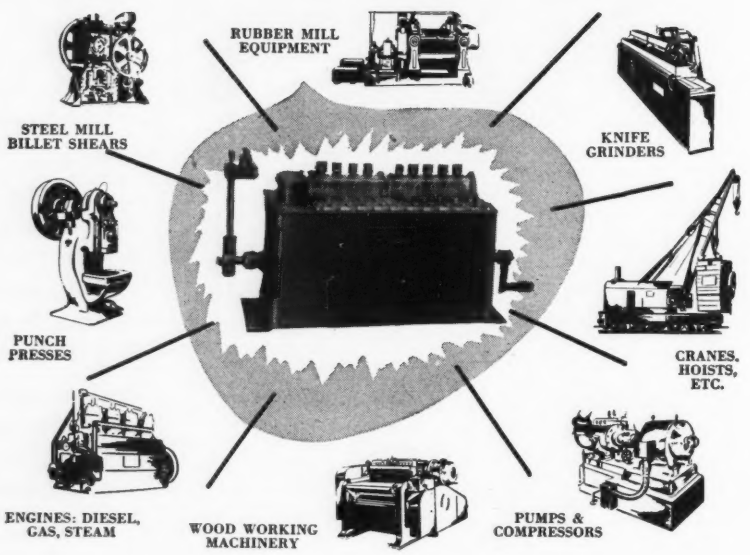

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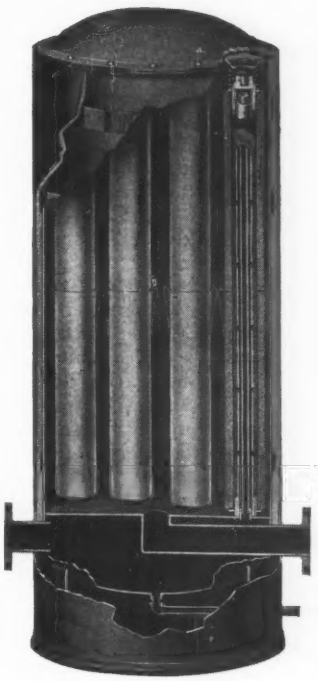

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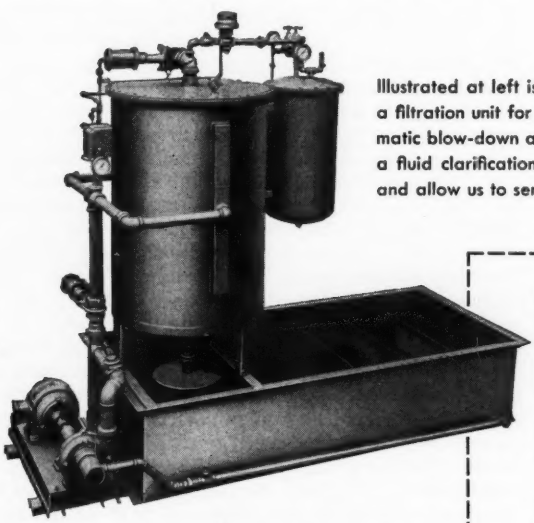
Honan-Crane Oil Purifiers completely remove all solids (abrasives), tarry matter and acids (which produce gums, "varnishes" and sludges). By operating on clean oil *continuously,* you *eliminate excessive wear* on precision surfaces; *realize* the *maximum efficiency* at which your equipment is capable of operating—and you *greatly extend the safe-use-life of the oil you use.*

Complete information on the purification of oil, case histories of the employment of oil purification and full details on *Honan-Crane Oil Purifiers* are available. Just fill out and mail the coupon.



Illustrated at left is a **Honan-Crane Liquid Clarifier** which has proved extremely valuable as a filtration unit for many fluids. It employs metal cloth as a filtering medium and features automatic blow-down action to clear the filter screen. It removes even microscopic solids. If you have a fluid clarification problem, please outline it to us by letter—or better still, mail the coupon and allow us to send a sales engineer.

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By A. BONDI
International Lubricant Corporation,
New Orleans, Louisiana

The Relation between

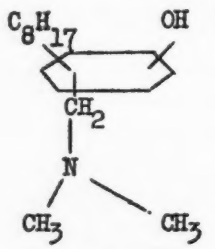
Flow Characteristics and Chemical Structure of Lubricants

THE operating conditions of lubricated parts in industrial and automotive machinery have, during the past three decades, become increasingly severe both as to width of temperature range, unit bearing pressures, and rubbing speeds. The large scale operation of synthetic gas fractionation at the temperature of liquid air or sub-stratosphere flying are at the low end of the temperature scale of the modern lubrication engineer, while the tribulations of the aluminum rolling mill or the continuous annealing oven operator may, at present, be considered the upper end. Unit bearing pressures of 3000 psi are not infrequently encountered in recent airplane engine design, while very much higher shockloads occur in quite a few bearings in industrial machinery. Rubbing speeds of 2000 inches per second have become a reality with the recent introduction of extreme high speed electromotors, some of which would turn at 120,000 rpm if the problem of their lubrication could be solved. In many cases the designing engineer has been confronted with the rather disturbing fact that the operability of his brainchild depended on such a "lowly" function as lubrication. More often than not the chemist has saved the day and obliged with a tailor-made lubricant.

Much of the work leading to the manufacture of new lubricants, to meet conditions never before encountered, has been in the past, more on the trial and error basis than on the grounds of sound fundamental relationships between the flow characteristics and the chemical nature of the liquids to be selected. As a result the technical personnel of lubricant manufacturing enterprises have had to become either walking encyclopedias of viscosity data, still running the danger of missing the one fluid which might do a better job, or to put their faith into modern theory of the liquid state and specifically of viscosity, to correlate the properties of liquids in such a manner that a substance of the desired properties could be synthesized or selected on the basis of the predictions of the theory.

Until very recently there was no theory of the liquid state sufficiently far advanced to offer even a remote possibility for the correlation of the required data. Even the mechanism of the flow of liquids, which I intend to outline here, is still less perfectly understood than theories which are ordinarily presented to engineering assemblies. But we believe that our hypotheses are close enough to the truth to give a quite general understanding of the behavior of lubricants under normal and extreme conditions of temperature, pressure and velocity gradient.

The progress in our understanding of the nature of the liquid state, which has been referred to above, is essentially due to the recognition of the close similarity between the liquid and the solid state, as in Figure 1. The "holes" in the structure which make possible such phenomena as creep in crystalline solids are somewhat more frequent in the structure of the liquid: Accordingly, flow under the influence of shearing stresses takes place more easily in the liquid. The overall state of order



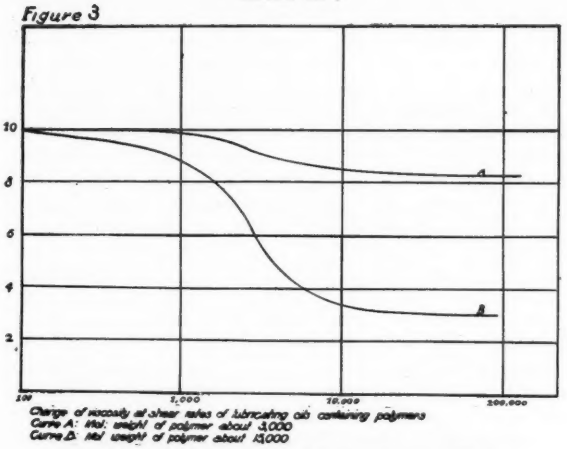
Dimethylaminomethyl octyl-phenol

is also not quite as pronounced in the liquid as it is in the crystalline solid. With increasing temperature the fraction of holes increases and at high temperatures the general nature of the liquid approaches the gaseous state. As a lubricant a liquid is mostly useful only in that temperature range in which it resembles a solid more than a gas. We shall, therefore, concentrate on this phase of its existence. In both the solids, as well as the liquid, the molecules perform oscillatory motions about their equilibrium positions. Accordingly, they have kinetic energy, but not all molecules of a given assembly have the same kinetic energy. There are always a few which have more than the rest, and a very few have enough to leap past the attractive fields of their neighbors when the opportunity arises; that is, whenever a hole appears big enough to accommodate their new equilibrium position. This happens all along. When the solid or liquid body is subjected to a shear stress, it is only natural that it will "give" or be strained where such a leap is taking place. We can, indeed, say that stress release takes place only through the action of these activated molecules, and that the ease with which a body can be strained or caused to flow is directly proportional to the concentration of such activated molecules. How many molecules have sufficient activation energy to pass by their neighbors depend on the tightness of packing of the whole system, the force fields around

* *Presented at the First Spring Meeting of the American Society of Lubrication Engineering, April 5 & 6, 1946, at Chicago, Ill.*

TABLE III

Figure 3



Change of viscosity at shear rates of lubricating oils containing polymers
Curve A: Mol. weight of polymer about 3,000
Curve B: Mol. weight of polymer about 13,000

Protective Requirements of Engine Preservatives

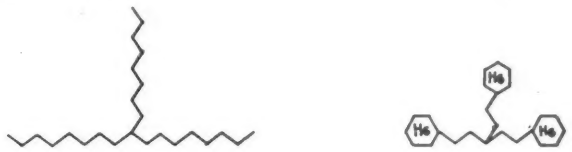
1. When blended one part of Base with three parts Grade 1120 AN-VV-O-446 aviation grade oil.

these neighbors and the form of the forre field as well as upon the temperature. It follows from elementary considerations that the number of activated molecules increases with temperature and viscosity decreases. The magnitude of the concentration of activated molecules follows from

$$\ln \frac{C_{\neq}}{C} = \frac{\Delta F_{\neq}}{RT} = \ln\left(\frac{V\eta}{Nh}\right) = \frac{\Delta H_{\neq}}{RT} - \frac{\Delta S_{\neq}}{R} \quad (1)$$

where all symbols have the usual meaning, $\neq$ indicating the change from the normal to the "activated" state. It is quite obvious that in a given combination of viscosity and molar volume there is a certain free energy of activation, $\Delta F_{\neq}$. But only the two terms in the expression to the right furnish us the desired information on the "why" of the observed viscosity value. $\Delta H_{\neq}$, the heat of activation, is a function of the force field of the neighbors trying to prevent motion. $\Delta S_{\neq}$, the entropy of activation, depends essentially on the change in the state of order which accompanies motion in the system considered. The meaning of these terms is illustrated in Figure 2. These two molecules have practically the same chemical composition. But one is threadlike in structure while the other consists of an arrangement of spheres. In terms of viscosity the result is low viscosity, low $\Delta H_{\neq}$, low $\Delta S_{\neq}$, for (A) and high viscosity, high $\Delta H_{\neq}$, high $\Delta S_{\neq}$, for (B). Even when we compare these two compounds at temperatures such that their viscosities are equal we observe significant differences in the origin of viscosity, $\Delta H_{\neq}$ and $\Delta S_{\neq}$ still being small for (A) and large for (B). From the point of view of the physicochemist this is easily understood. Threadlike compounds, as represented by (A), are known to be loosely packed, gaining about 15% in volume when changing from the solid to the liquid state. Since the force fields of neutral molecules change with the inverse 6th power of the distance, $\Delta H_{\neq}$ is small for (A), whereas for (B) which belongs to a group gaining but a few per cent in volume on melting, $\Delta H_{\neq}$ is rather large. It is possible because of a most characteristic effect, for both compounds to have the same viscosity. Threadlike molecules have a tendency to curl up when at rest. When brought in motion they tend to straighten out, and the overall state of order increases, whereupon entropy decreases, causing an increase in viscosity, compensating for the small $\Delta H_{\neq}$. The spherical nature of the components of structure (B) makes for tight regular packing in the liquid state. Movement out of the existing equilibrium position is therefore of necessity connected with a considerable increase in disorder and in entropy. Since nature prefers processes which augment disorder, flow becomes easier by an amount sufficient to compensate for the high energy barrier $\Delta H_{\neq}$. As an extreme example for this mechanism, at a viscosity of 50 poise, dihydrodiamyl anthracene, a typical spherical molecule, has $\Delta H_{\neq}$= 22 kcal/Mole. and $\Delta S_{\neq}$=42 E. U. while the long thread polyisobutylene of $\overline{M}v$ 4900 at the same viscosity

Figure 2



M-	352	346
d_{20}^{20} -	0.790	0.903
ν_{20} (Stokes)	0.16	7.30
ΔH_f (kcal)	5.87	14.67
ΔS_f (E.U)	1.0	23.5
ΔF_f (kcal)	5.56	7.78
at ν = 0.10 Stokes		
ΔH_f (kcal)	5.70	9.0
ΔS_f (E.U.)	0.2	7.0
ΔF_f (kcal)	5.50	6.7

1. When blended one part of Base with three parts Grade 1120 AN-VV-O-446 aviation grade oil.
2. This test shall be made in accordance with method 321.1 of Federal Specification VV-L-791.

has $\Delta H_{\neq}$ = 12 kcal/Mole. and $\Delta S_{\neq}$ = — 2.0 E. U. The relationships are quite general and for neutral molecules practically independent of the chemical composition. The extremely low values of $\Delta H_{\neq}$ corresponding to high Viscosity-Index numbers, of the many synthetic lubricants which have recently entered the market are all connected with liquids comprised of long threadlike molecules, whether they are esters, silicone ethers or long chain polymers in oil solution. All these have in common the fact that their viscosity is essentially due to the decrease in entropy or co-ordination of all the chain links required for flow activation. The relatively weak force fields of these molecules contribute but little to the viscosity through the small $\Delta H_{\neq}$. There is, however, another side to this picture. As desirable as low $\Delta H_{\neq}$ and high V.I. are, the weak intermolecular forces which are apparently a prerequisite for their realization also cause very weak adhesion of the molecules to metal resulting in the bearing failures which have been reported for two members of this class—certain silicones and polyisobutylenes—at relatively low unit loads. Only after their $\Delta H_{\neq}$ had been increased from about 3,600 to 7,400 did the intermolecular forces of the silicones approach the value required for good metal-liquid interaction or adhesion. Introduction of active and surface active groups always increases $\Delta H_{\neq}$ and decreases the V.I. because of their strong force fields. The force fields and $\Delta H_{\neq}$ of some of the most active film strength additives are indeed so strong that they decrease the V.I. perceptibly even at relatively low concentrations.

On lowering of the temperature, straight threadlike molecules tend to aggregate in a regular manner and cause the liquid to crystallize. We can prevent that by tacking a little branch on to the molecule here and

there so that it becomes more difficult for various neighbors to line up as correctly as is necessary to form a crystal. As a result, the liquid will crystallize only at much lower temperature, if at all. But at low temperatures the molecules seem to remember that they really should be solid and come so close together that they and the viscosity rise rapidly as the temperature goes down, causing the well-known "kink" in the low temperature viscosity curve of glassifying liquids. This can be prevented by reducing the depth of the potential energy box which the neighbors form around the reference molecule. This is easily done by mixing two or more liquids of quite different molecular weight, or structure. The experienced hydraulic oil blender will be quite familiar with this trick.

The effect of pressure on viscosity is expressed in the terms of the above theory, which is due to Eyring and his coworkers, by

$$\left(\frac{I\Delta F_{\neq}}{Ip}\right)_T = \Delta V_{\neq} \qquad (2)$$

where $\Delta V_{\neq}$ is the increase in hole size required for the microscopic jump to take place. I have recently shown that $\Delta V_{\neq}$ and $\Delta H_{\neq}$ are quite closely related so that, as a rule, $\Delta H_{\neq}$ will be small whenever $\Delta V_{\neq}$ is small, and vice versa. This means that lubricants of high V.I. should have lower viscosity-pressure co-efficients than lubricants of low V.I. There is much experimental evidence for this rule. It has previously been pointed out that a high viscosity-pressure coefficient provides a material safety factor whenever high shockloads in bearings are expected, by permitting a strong increase in viscosity and thereby in load carrying capacity of the oil film, when it is most needed. Low and medium V.I. oils are in such cases safer to use than high or especially "Super" high V.I. oils, for the former's stronger decrease in viscosity with temperature will be much more than compensated by their viscosity increase with pressure. Table 2 gives a self-explanatory correlation of viscosity pressure effect with chemical constitution. Much more experimental data are needed, however, to provide a clear picture of the effect of various additives on the high pressure viscosity.

Much speculation has for the past 15 years centered around the effect of high velocity-gradients on the viscosity of oils. The thought that the molecules would align themselves with axes parallel with the direction of flow at high velocity gradients was certainly enticing, and the experiments of Kyropoulous, who could observe a significant reduction in viscosity at high shear rates, seemed to confirm such a hypothesis. But the mathematical analysis of the heat balance around a moving oil film by several later investigators showed that the temperature gradient across a rapidly sheared oil film could account for a major portion of Kyropoulous' effect. A theory of the flow orientation process was developed by the writer which showed that ordinary lubricating oils should not show significant flow orientation at the normally encountered rubbing speeds. Here the observed viscosity could be accounted for by the temperature gradient, as has also been proven recently by experiment. Lubricating oils consisting of or containing substantial portions of threadlike molecules in excess of a certain length/diameter ratio should, however, show a strong viscosity drop due to flow orientation of these long molecules. This effect, which depends on the square of the molecule's length, has been observed experimentally as indicated in Figure 3. Since the load carrying capacity of a bearing increases at a given viscosity linearly with the angular velocity of the shaft, while there is actually no need for this increased load carrying capacity, it is conceivable that such flow orientating high polymer solutions may be designed for extremely high speed machinery where a high viscosity is required when starting but most undesirable when running.

In summarizing this short outline, it may be stated that our present theory of viscosity, which is mainly due to Eyring and his coworkers, incomplete as it may still be, explains consistently all observed phenomena, and permits us to predict that the viscosity characteristics of a liquid are nearly independent of the chemical composition and depend mainly on the geometry of the liquid structure and of the molecules themselves. It thus becomes immaterial whether we have hydrocarbons, esters, ethers or silicones as long as the form of the molecule is in accordance with the desired viscosity characteristics: Threadlike for low viscosity at high boiling point, low temperature and low pressure susceptibility of viscosity, and spherical for high viscosity at low molecular weight, high temperature and high pressure susceptibility of viscosity. The introduction of active groups increases the viscosity and the temperature and pressure susceptibility of viscosity by increasing the strength of the intermolecular force field. The shear rate dependence of viscosity of homogeneous liquids can also be expressed as a function of geometrical parameters of the liquid's molecules. The practical result of these considerations is the recognition that the desired hydrodynamic properties of a lubricant can be obtained from a wider variety of compounds than had before been thought possible, opening an apparently closed field for keen competition so that we will be provided with better and better lubricants at lower and lower prices.

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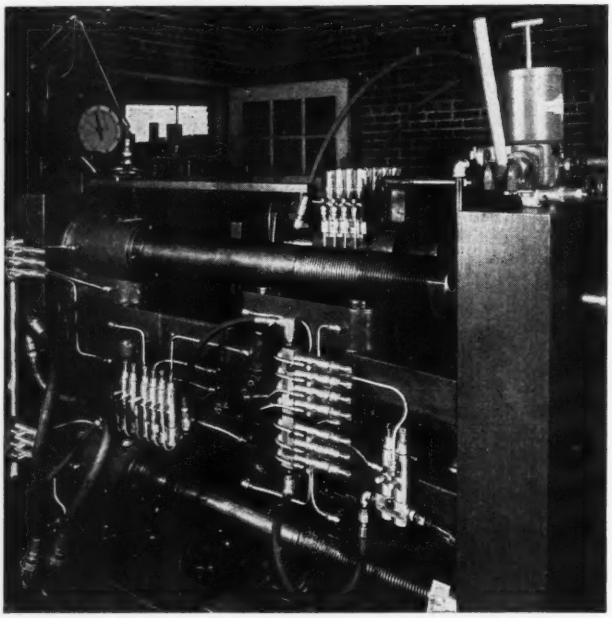

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NEWS OF THE SECTIONS

CHICAGO

Golf tournaments seem to hold the attention of many sections as the closing activities of the season. At Chicago, Alfred A. Paul of the Brooks Oil Company was awarded the prize for low score, having negotiated the difficult Cog Hill Country Club Course in 82. Genial Bill Youngclaus acted as chief engineer at the banquet following.

There were many prizes that had been donated by suppliers and members and an excellent dinner was served. Mr. D. N. Evans, as chairman of the Committee for arrangements, was highly complimented on the success of the party.

Technical meetings will be resumed in September.

We have just received word that Alfred Paul, while attending a three-day golf and business session of the Brooks Oil Company in the Pennsylvania Hills came through with a 77. That's good golf, and the Chicago Section asks if any other Section cares to arrange a match for the A.S.L.E. National Championship.

PHILADELPHIA

The Philadelphia Section has made extensive plans for five meetings for the coming season starting in September. Several novel features are under way and will be announced in a later issue.

LOS ANGELES

The Los Angeles Section is looking forward to a full quota of monthly meetings during the 1947-1948 season, starting in September, having recessed at their last meeting in June for the summer.

MILWAUKEE

The Milwaukee Section closed its active season with a dinner at the Hotel Medford on May 19. The new Officers were installed and the Section entertained as guests national officers O. L. Maag, President, Norman C. Penfold, Midwest Vice-President, and W. F. Leonard, Secretary. D. W. Johnson presided as toastmaster and kept events moving at a rapid pace.

The Section Officers have made plans to resume their lecture series and technical meetings in September.

DETROIT

The Officers of this Section are making extensive preparations for a full season of technical and social meetings for the coming season, the first of which will occur on the evening of Monday, September 22 and regular dinner meetings every fourth Monday of the month thereafter. The members have been very active in technical society work in this area and have recently affiliated with the Engineering Society of Detroit, which will give them one of the finest meeting places in the Eastern Division.

Full information on programs will be published in an early issue.

DAYTON

A large and enthusiastic group gathered at the Engineers Club in Dayton on the night of May 20 for the purpose of organizing a Dayton Section of the A.S.L.E. National President, Oscar L. Maag gave an interesting outline of the Society's activities. The national by-laws were adopted and complete organization was effected, with the following Officers:

Chairman, R. F. McKibben; Secretary-Treasurer, R. Lyle Brace.

A business meeting is called for September 9, and the first technical session will be on the evening of September 23. Mr. Leo Salzberg of the Air Materiel Command, Wright Field, Dayton, will speak on "What is a Lubricant?"

ST. LOUIS

On the night of May 20, a group of 37 men interested in the subject of lubrication met at one of the meeting rooms of the Washington University in this city. National Secretary W. F. Leonard acted as temporary chairman of the meeting, explaining the aims and accomplishments of the Society. A copy of the national by-laws was thereupon adopted and Sectional Officers elected as follows: Chairman, Prof. L. M. Tichvinsky, Dept. of Mech. Eng., Washington University, St. Louis, Mo.; Vice-Chairman, Dr. J. F. Palmer, Jr., Research Chemist; Secretary-Treasurer, Mr. T. V. Picraux.

Arrangements are being made for a total of eight technical meetings to be held on the third Tuesday of each month, beginning Tuesday, October 21, 1947, and terminating Tuesday, May 18, 1948. Meetings will be at the South Dining Room of the Gatesworth Hotel, Union Blvd., where full-course dinners will be served prior to the meeting at an approximate cost of $2.25 per person.

Among the speakers are Mr. A. F. Underwood, Research Division, General Motors Corporation, Detroit, Michigan; Mr. John Boyd, Research Laboratories, Westinghouse Electric and Mfg. Corp., East Pittsburgh, Pa., and Mr. F. C. Linn of the General Electric Co., Schenectady, New York. Other men, prominent in our field, will be heard, and it is believed that a most interesting and instructive series of papers will be presented during the coming 1947-8 season.

PITTSBURGH

The summer outing of the Pittsburgh Chapter was held July 11 at the Youghiogheny Country Club, McKeesport, Pa. A good attendance of members and guests enjoyed a very excellent golf course. The prize for low gross was won by Mr. Jack McPhee of Youngstown. At the dinner which followed, Mr. McPhee gave a very interesting talk, followed by moving pictures illustrating his topic of "Football Officiating." Plans are already under way for a resumption of technical activities with a series of meetings starting in September and continuing until next June.

We are very sorry to announce the death of James McLaughlin of Freedom Valvoline Company, a former member of the Pittsburgh Section of the A.S.L.E., at Pittsburgh, July 12.

BUFFALO

The last dinner meeting of the season was held at King Edward Hotel in Toronto, with members and guests from Syracuse, Rochester and Canada. Dr. R. G. Larsen, Western Vice-President of the A.S.L.E. was the guest speaker with the subject, "Recent Trends in Research on Lubricants." In his usual forceful manner, Dr. Larsen presented to an enthusiastic audience many novel ideas on developments and trends.

Early September will see a resumption of the meetings which have closed during the summer months.

A meeting of the Convention Committee, headed by Walter Peuchen as Chairman and James Courtright, Co-Chairman, with National Secretary W. F. Leonard was held in the Statler Hotel, June 27. Arrangements were completed with the hotel management for the meeting and committee rooms and hotel accommodations for the 1948 Convention will be held April 19, 20 and 21.

Extensive plans are already under way by the local committee for entertainment of members and guests.

NEW YORK

The New York Section held their annual dinner meeting at the Midston House on May 15. Eighty-five members and guests attended the dinner, with a total of 150 people at the meeting which followed. This Section has adopted a new banner which formed a background for the speaker's table, with dimensions 6 ft by 4 ft—the A.S.L.E. standard emblem was of gold-colored felt on a green background with "American Society of Lubrication Engineers" spread across the surface and to the left with the words, "New York Section." The entire banner has a 2-in. gold-colored felt border and is an attractive addition to the meeting room.

Mr. Oscar L. Maag was present at the meeting and gave an interesting talk on the progress that was being made in the various Sections and in the national organization. The following list of officers were elected for the term of the year: Chairman, A. J. Zino, Jr.; Vice-Chairman, William E. Campbell; Secretary, Henry Muller; Treasurer, E. H. Erck.

A symposium on Machine Tool Lubrication from various points of view and including a general discussion of the subject followed after the three papers were presented. The usual summer recess will be taken until September.

CLEVELAND-YOUNGSTOWN

Cleveland-Youngstown Section closed its fiscal year with a dinner meeting May 27 at the Cleveland Engineers Society. Mr. H. V. Nutt of the U. S. Naval Experiment Station at Annapolis, Md., gave an extremely interesting and educational paper entitled, "Oil Filters," in which he went into various phases of efficient filtration. The election of officers followed with the election of Lee W. Fitch as Chairman, Chester Zatwarsky as Vice-Chairman, Thorton Lake as Secretary and John L. Finkelmann as Treasurer.

The Aurora Country Club at Cleveland was the scene of the Golf Tournament and dinner of this Section. Prize for low score was awarded to H. W. Jones of Penola, Inc., who shot an 82. The course is tricky and treacherously landscaped. We understand that computations are still being made on the high gross. Many prizes, donated by the Society members and suppliers in the Northern Ohio area were awarded to golfers and those attending the dinner.

It was a very enjoyable occasion and included tentative plans for a clambake in September, after which technical activities will be resumed.

NORTHERN CALIFORNIA

A meeting of the Executive Committee of this Section was held in Emeryville, Calif., at which extensive plans were made for the coming season, the first meeting to be held October 2. The main subject will be "Lubrication of Food Machinery." Mr. Boyce will have charge of the program.

The meetings for the coming season will be held at the Officers' Club on Treasure Island. The facilities are ideal and Treasure Island is located in the middle of San Francisco Bay, a magnificent setting. Every A.S.L.E. visitor to the Bay area will greatly enjoy the trip over to the island. Prospective visitors from other Sections please bear in mind the meeting dates of October 2, November 6, December 4, January 8, February 5 and March 4. The subjects of these meetings will be published at a later date.

MACHINE TOOL CONFERENCE

"Machine Tools and the Philosophy of Production" will be discussed by George Habicht, Jr., President, American Machine Tool Distributors' Association, at the September 23 meeting of the Chicago Technical Societies Council. This will represent the Council's participation in the Machine Tool Congress of September 17 through 26. The Chicago section of the American Society of Lubrication Engineers is affiliated with the Council. Held concurrently with the great Machine Tool Show at the Dodge-Chicago Plant, the Congress will include meetings by the American Machine Tool Distributors' Association, the American Society of Mechanical Engineers, American Society of Tool Engineers, American Foundrymen's Association, National Electrical Manufacturers Association, and the Society of Automotive Engineers. President of the Congress Board of Directors is Kenneth H. Hobbie, Past President of the Chicago Technical Societies Council, and Vice President of Driver-Harris Company.

Through its affiliation with the Council, the Chicago Section of A.S.L.E. is given frequent opportunities to participate in events of this kind. Mr. W. F. Leonard, National Secretary of the American Society of Lubrication Engineers, has been named as Program Chairman, for the Council, in an effort to bring about the better coordination of the programs of the 51 separate Societies that go to make up the Council. During March 22, 23 and 24, 1948, it is expected that the section will play an active part in the Council's annual Conference and Production Show. We shall be asked to contribute to one or more of the Conference sessions and our national organization will be represented by a booth at the show in order to stress the importance of the modern science of lubrication to profit-minded executives. Attendance at the Show is expected to exceed the 1947 figure of 27,000.

The Chicago Technical Societies Council is a federation of 51 local chapters of national societies in the fields of science, engineering and technology. Offices are maintained at 53 West Jackson Boulevard under Executive Secretary Paul A. Jenkins.

OILS AND LUBRICANTS PATENT ABSTRACTS

Processing of Castor Oil—Patent #2,418,819—George F. Coggins and John Francis Ahearn, assignors to Aerovox Corp. The process of removing free acid from casetor oil/of the type that forms stable emulsions with water, which consists in bringing into contact with the oil a neutralling agent in aqueous solution, bringing the oil together with the soap stock formed therein into contact with substantially the minimum quantity of fuller's earth capable of complete removal of the soap stock and finally separating from the oil solid and absorbed aqueous matter, including the soap stock.

Process for Purifying Hydrocarbon Oils—Patent #2,418,884—Charles O. Hoover, assignor to Air Reduction Co., Inc. The method of treating sour hydrocarbon oil which comprises passing the oil in the presence of an added oxidizing agent and an added mineral acid successively through a turbulent zone and a superposed quiescent zone, each consisting of a slurry of solid particles comprising a mixture of an adsorbent material and a copper compound suspended in the hydrocarbon oil.

Compounded Lubricating Oil—Patent #2,418,894—John G. McNab and Dilworth T. Rogers, assignors to Std. Oil Development Co. A compounded lubricant comprising a mineral lubricating oil base and at least a corrosion-inhibiting amount of a reaction product of about 0.02 to about 3 atomic proportions of elemental sulfur with one molecular proportion of a metal salt of sulfonic acid.

Process of Dispersing Oil Gels—Patent #2,418,920—Henry G. Berger, George S. Crandall, and John F. Socolofsky, assignors to Socony-Vacuum Oil Co., Inc. The process which comprises dispersing a gel of an oil of the class consisting of drying and semi-drying oils in an oil of said class with the aid of a small amount of a heterocylic organic nitrogen compound as a dispersing agent.

Process of Bodying Drying Oils and the Product Resulting Therefrom—Patent #2,418,921 — Henry G. Berger, and George S. Crandall and John F. Socolofsky, assignors to Socony-Vacuum Oil Co., Inc. The process which comprises gelling an oil of the class consisting of oiticica oil, perilla oil, dehydrated castor oil and mixtures of linseed oil by treating sad oil with a gelaton catalyst of the class consisting of hydrogen fluoride and boron fluoride at a moderate temperature and in sufficient quanity to form a gel of about the consistency of art gum, and dispersing the gel so formed, with the aid of a dispersing agent, in an oil of the class consisting of unbodied drying and semi-drying oils by distributing the gell throughout the oil in which it is to be dispersed, the particles of the gel as dispersed being no larger than small lumps, and heating the mixture to a temperature of at least around 500°F.

Lubricant and the Like—Patent #2,419,153—John M. Musselman and Herman P. Lankelma, assignors to The Standard Oil Co. In a process of preparing lubricants, reacting an unpolymerized organic oxygen-containing compound forming oil soluble metal phosphorus sulfide reaction products and having a boiling point not less than 300°F. with phosphorus pentasulphide at a temperature above phosphate formation, and converting the product into a barium compound.

Tall Oil Treatment—Patent #2,419,211—George C. Harris, assignor to Hercules Powder Co. The method of separating the resin acids from tall oil which comprises dissolving tall oil in an organic solvent selected from the group consisting of acetone, isopropanol, Hi-Flash naphtha and gasoline, and precipitating the resin acids from the resulting solution at a temperature between about −10°C. and about 50°C. with a primary organic amine selected from the group consisting of cyclohexylamine, p-dodecahydroxyenylamine and 2-amino-2-methyl-1-propanol.

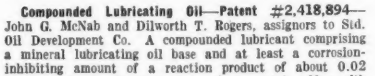
Lubricant—Patent #2,419,253—Lysle D. Cahill, assignor, by mesne assignments, to Jack and Heintz Precision Industries, Inc. In combination in a friction clutch assembly having a plurality of clutch discs with friction surfaces, a lubricant between said surfaces, said lubricant consisting essentially of a grease base having mechanically suspended therein a finely divided, impalable solid scarifying agent for making minute grease-retaining scratches on a wearing surface lubricated thereby, whereby said lubricant will not be completely squeezed out or rubbed off said surface by the imposition of frictional loads thereon, the proportions of the elements of said lubricant being approximately one part by weight of said agent with 200 parts of grease.

Lubricating Composition—Patent #2,419,325—John M. Musselman, assignor to The Standard Oil Company. A new lubricating oil composition of matter comprising a major portion of a lubricating oil and an amount of an additive sufficient to improve the stability of the lubricating oil, said additive comprising the metal compound of the reaction porduct of an oxygenated petroleum hydrocarbon boiling above the hereinafter named reaction temperature and an amount of phosphorus pentasulphide within the range of 14 to 30% and at least stoichiometrically sufficient to supplant the oxygenated petroleum hydrocarbon with sulphur, reacted at a temperature within the range of 275 to 425°F. to form a reaction product separablefrom a sludge comprising the major part of the phosphorus in the pentasulphide, and subsequently converted into said metal compound.

Printed copies of patents are available from the Patent Office at 25c each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 597, Nos. 3, 4, 5; Vol. 598, Nos. 1, 2, 3, 4; Vol. 599, Nos. 1, 2, 3, 4; Vol. 600, Nos. 1, 2, 3.

Lubricating Oil Composition—Patent #2,419,360—John G. McNab, Carroll J. Wilson, and Carl Winning, assignors to Standard Oil Developing Co. An organic composition containing a small quantity, sufficient to composition containing a small quanity, sufficient to impart detergent properties, of an organic compound of the formula



where R is a member of the group consisting of aliphatic and aromatic radicals which are free from carboxyl and metal substituted carboxyl groups, M is a member of the class consisting of metals and basic radicals, and the oxygen is attached to a carbon atom which is attached only to carbon, hydrogen or nitrogen, and a small quanity, at least sufficient to offset the corrosive effect of the first-named compound, of a product obtained by reacting para-cresol with a reagent which furnishes a tertiary alkyl group, in the presence of an alkylation catalyst.

Mineral Oil Composition—Patent #2,419,584—Thomas T. Noland, assignor to Socony-Vacuum Oil Co., Inc. A mineral oil composition comprising a viscous mineral oil fraction containing a minor proportion,, from about 0.1 per cent to about 3.0 per cent, sufficient to inhibit the deteriorating effects of oxidation upon the oil, of a stable, oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction of phosphorus pentasulfide and a hydrocarbon stock at a temperature between about 125°C. and about 200°C. for a relatively short reaction time, said hydrocarbon stock being characterized by an olefin content of from about 3 per cent to about 7 per cent and an aromatic content of from about 40 per cent to about 60 per cent, said phosphorus pentasulfide representing from about 1 per cent to about 8 per cent by weight of the said hydrocarbon stock, and the said reaction product normally tending to form a haze in the oil; and a minor proportion, from about 0.001 per cent to about 0.3 per cent, sufficient to suppress the formation of said haze, of an oil-miscible metal salt of a sulfonic acid.

Mineral Oil Composition—Patent #2,419,586—Ferdinand P. Otto and Ronald E. Meyer, assignors to Socony-Vacuum Oil Co., Inc. An improved mineral oil composition comprising a viscous mineral oil fraction having in admixture therewith a minor proportion, sufficient to stabilize said oil fraction, of a non-corrosive, sulfurized aliphatic ketone obtained by sulfurizing an unsaturated aliphatic ketone with elementary sulfur at an elevated temperature, said ketone having at least one olefin group separated from the keto group by at least one carbon atom.

Saw Blade Lubricant—Patent, #2,419,713—Edmund L. Flood, assignor to Consolidated Vultee Aircraft Corp. A saw blade lubricant composition comprising on a weight basis, from 70 to 80% of a wax having a melting point of at least about 143°F. taken from the group consisting of paraffin wax, carnauba wax, ceresin wax and candelilla wax, from 20 to 30% of a soda base grease, from 4 to 5% of a cutting oil taken from the group consisting of turpentine, rosin oil and pine oil and .5 to .7% of aluminum stearate.

Chemical Treatment of Oil Sands—Patent #2,419,755 Frederick W. Albaugh, assignor to Union Oil Co. of California. A method of treating water-wet oil sands for increasing their effective permeability to oil which comprises contacting said sands with hydrocarbon oil solution of an organic heterocyclic polycyclic amine of the class consisting of quinoline and its homologs, which does not substantially affect the water-oil interfacial tension.

Lubricant—Patent #2,420,068—Gordon W. Duncan and John C. Zimmer, assignors to Std. Oil Development Co. An improved lubricating oil composition consisting of a mineral lubricating oil containing from 0.5 to 5% of an oil-soluble hydrophilic polyvalent metal containing derivative of an organic compound, said metal compound possessing engine detergent properties, and from 0.01 to 0.3% of an aliphatic primary amine containing from 8 to 22 carbon atoms per molecule.

Sweetening Hydrocarbon Oils—Patent #2,420,218—George W. Ayers, assignor to The Pure Oil Co. The method of removing sulfur compounds from hydrocarbon oils comprising contacting said oil with an aqueous solution of a compound selected from the group consisting of alkali metal hydroxides and carbonates in the presence of a comminuted alloy comprising a metal selected from the group consisting of copper and nickel and an element selected from the group consisting of silicon, beryilium, aluminum and zinc.

Heavy Duty Motor Oil Composition—Patent #2,420,274—Norman D. Williams and William J. Backoff, assignors to The Pure Oil Co. The method of preparing a lubricant additive comprising preparing a saponified fatt semi-wax material containing in chemical combination therewith a small amount of a phosphorus sulfide, separating the resulting product into two unequal portions, heating the major portion for a short time to a temperature of about 300 to 350°F. sufficient to remove traces of moisture and objectionable odor but insufficient to decompose it and reblending it with the minor unheated portion.

Lubricant and Method of Making Same—Patent #2,420,280—John S. Yule and Harry L. Moir, assignors to The Pure Oil Co. The method of preparing a lubricant comprising cooking sulfurized and phosphorized fatty material, prepared by reacting fatty material with 5 to 9% by weight of sulfur at temperatures not in excess of 340°F. until the product gives a good copper strip corrosion test, and then reacting the sulphurized material with sufficient phosphorus-sesquisulfide to incorporate therein between 0.2 and 0.6% by weight of phosphorus at a temperature approaching but not in excess of 230°F., with from about 2 to 8% by weight of sulfur at a temperature of approximately 270-300°F. and for a period of time, between about 2 and 2 hours, sufficient to cause the sulful to become incorporated in the product in a loosely bound form in which it will not separate from the product upon cooling to atmospheric temperatures.

Lubricant for Processing Metals—Patent #2,420,328—Joseph Harrel Shipp and Charles J. Pedersen, assignors to E. I. duPont deNemours and Company. An aqueous emulsion of a distillation residue derived from a hydrogenated natural fatty oil by distilling off fractions up through octadecyl alcohol, in which the emulsifying agent is an surface-active water-soluble non-acidic salt of a long-chain alkyl acid-ester of phosphoric acid, the distillation residue being present in a concentration of from about 1 to about 70% and the emulsifying agent being present in a minor proportion sufficient to form a substantially stable emulsion.

Lubricant for Processing Metals—Patent #2,420,329—Joseph Harrel Shipp, Osborne Coster Bacon and Charles J. Pedersen, assignors to E. I. duPont deNemours and Co. On aqueous emulsion of a distillation residue derived from a hydrogenated natural fatty oil by distilling off fractions up through octadecyl alcohol, in which the emulsifying agent is a surface-active water-soluble non-acidic salt of a long-chain alkyi acid-ester of phospheric acid, the distillation residue being present in a concentration of from about 1 to about 70% and the emulsifying agent being being present in a minor proportion sufficient to form a substantially stable emulsion, said emulsion having "Tetralin" incorporated therein in an amount sufficient to substantially inhibit foaming during use.

Drying Oil Coating Compositions—Patent #2,420,390—Thomas C. Whitner, assignor to Chemical Laboratories, Inc. A coating composition comprising a drying oil, a pigmentic agent consisting of a drying oil substantially insoluble condensation product of a saturated acyclic aldehyde with a saturated acyclic ketome and containing an absorbed dye, and a drying agent for said oil.

Petroleum Oil Compositions—Patent #2,420,446—Albert G. Rocchini and Charles Byron Pattinson, Jr., assignors to Gulf Research and Development Co. A mineral oil composition comprising a major amount of a petroleum lubricating oil and a minor amount of benzaldehyde phenylhydrazone sufficient to retard halogenation of said petroleum lubricating oil.

Process for Treating a Liquid with a Suspension of Solids by Passage Thereof Through a Separator, Regenerating the Separated Solids for Re-Use with Untreated Liquid—Patent #2,420,761—Charles L. Thomas, assignor to Universal Oil Products Co. In the refining of hydrocarbon oil by treatment thereof with particles of solid adsorbent material to remove impurities from the oil, the method which comprises passing a suspension of the solid adsorbent particles in the oil upwardly through a treating zone, separating solid particles containing impurities from the treated oil by gravity in an upper region of said zone, passing the separated particles downwardly by gravity through an ascending stream of wash liquid for adhering hydrocarbons, thereafter suspending the solid particles in a liquid solvent for adsorbed impurities and passing the resultant suspension upwardly through a second zone, separating thus treated particles by gravity from said liquid solvent in an upper region of the second zone and passing the same downwardly by gravity through an ascending stream of additional liquid solvent.

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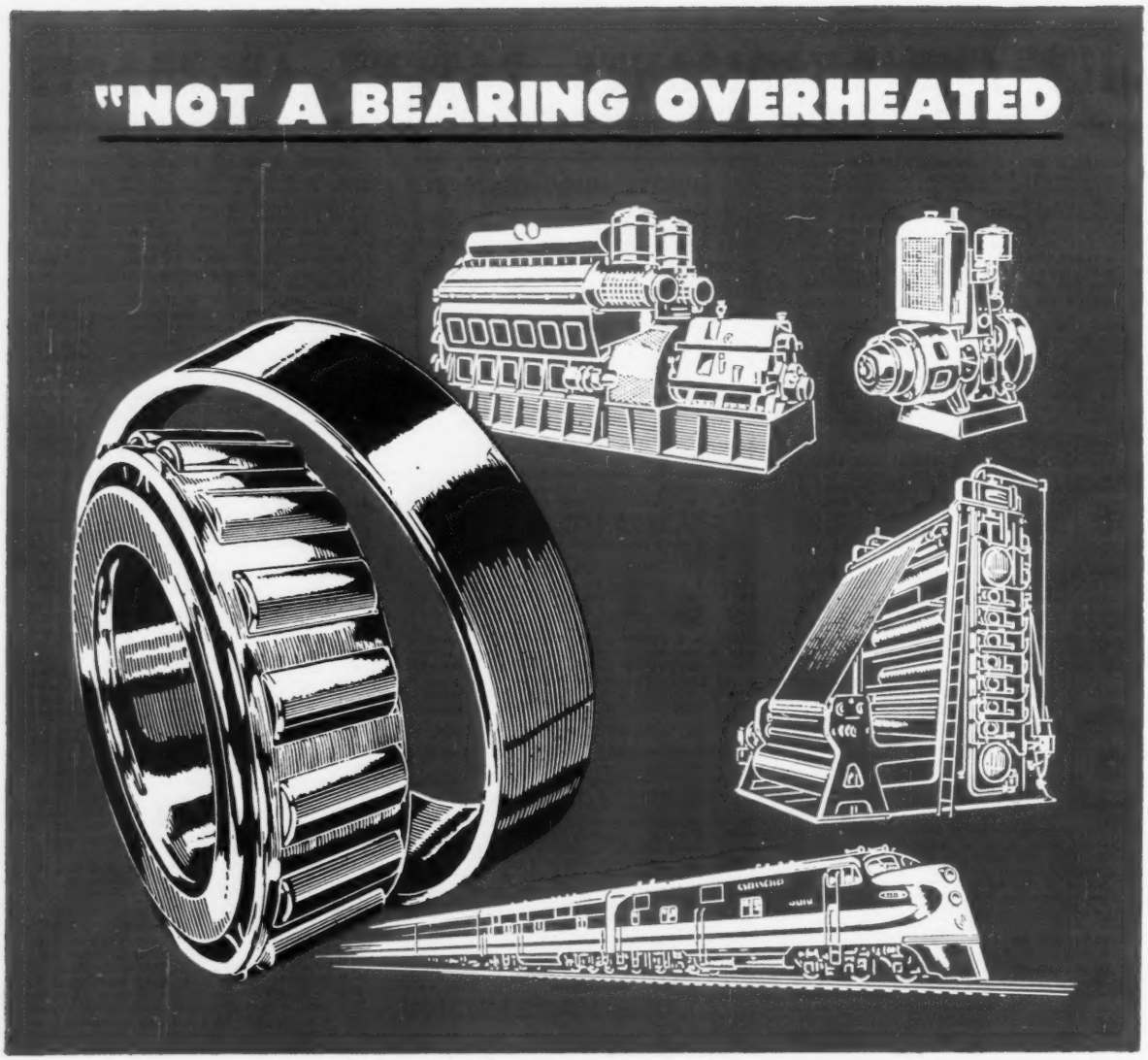

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and then returning the solid particles to the first-mentioned zone in suspension in a further quantity of the oil to be refined.

Application of Solid Lubricant Coatings to Surfaces—Patent #2,420,886—Carthrae M. Laffoon, Jr., assignor to Westinghouse Electric Corp. The method of applying to a surface of a member composed of a metal other than tungsten or molybdenum a tenaciously adherent coating of a solid lubricant of a metallic compound selected from the class consisting of sulfides, selenides and tellurides of tungsten and molybdenum, comprising electroplating the surface of the member to deposit thereon an adherent elctroplate of the metal component of the compound and heat treating the electroplated surface at a temperature of from about 600 to 140°C. in an atmosphere consisting of at least one of the group consisting of sulphur, sulfide, selenide, and telluride gases to convert the electroplated metal to produce only the corresponding disulfide, selenide, and telluride to provide for the solid lubricating metallic compound being formed on the surface of the member.

Compound Lubricating Oil—Patent #2,420,893—John G. McNab and Charles L. Fleming, Jr., assignors to Std. Oil Development Co. A mineral lubricating oil containing a stabilizing quantity of a metal salt of a thiophosphoric acid ester of an octyl phenol sulfide.

Lubricating Composition—Patent #2,420,902—Arnold M. Morway and John C. Zimmer, assignors to Std. Oil Development Co. A lubricant comprising 5-30% of water-insoluble metal soap wherein the metal of said soap is selected from the group consisting of lithium, calcium, barium, and strontium, 70—95% of an isomeric mixture of chlorinated diphenyl of 48% average chlorine content on a weight basis, from 0.1 to 1% of aluminum stearate and from 0.1 to 1% of zonc naphthenate, said lubricant having a density greater than that of sea water.

Lubricant—Patent #2,420,953—Russell A. Hunt, Jr., assignor to Std. Oil Co. A hydrocarbon oil composition resistant to copper plating comprising a hydrocarbon oil normally susceptible to cause copper plating in the presence of a copper-containing metal, a copper deactivator and tricresyl phosphate, said copper deactivator and said tricresyl phosphate being used in small but sufficient quantities to inhibit the copper plating by said hydrocarbon oil, said copper deactivator being the reaction product of an aliphatic polyamino compound having at least two primary amino nitrogen atoms and an aromatic compound selected from the class consisting of aromatic ortho hydroxy aldehydes and ortho hydroxy aromatic ketones.

Mineral Oil Composition—Patent #2,421,004—Henry G. Berger and Everett W. Fuller, assignors to Socony-Vacuum Oil Co., Inc. An improved mineral oil composition comprising a viscous mineral oil fraction having in admixture therewith: a minor proportion, from about 0.5 to about 10%, of an oil-soluble salt characterized by detergent action in oil; and a minor proportion, from about 0.05 to about 5.0%, of an oil-soluble, phosphorus- and sulfur-containing reaction product obtained by reaction of phosphorus pentasulfide and a hydrocarbon stock at a temperature between about 125°C. and about 200°C. for a relatively short time, said hydrocarbon stock being characterized by an olefin content of from about 3 to about 7% and an aromatic content of from about 40 to about 60%, and the said phosphorus pentasulfide representing from about 1 to about 8% by weight of the said hydrocarbon stock.

Process of Obtaining Polar Type Corrosion-Inhibiting Agents Soluble in Petroleum Lubricating Oils—Patent #2,421,040—James E. Shields and Edward V. Reilly, assignors to Alox Corp. Process of obtaining polar type corrosion inhibiting agents soluble in petroleum lubricating oils and insoluble in water from mixtures of substantially unsaponifiable oxygenated predominately aliphatic and saturated hydrocarbons derived from a petroleum fraction by the liquid phase partial oxidation of the latter using an oxygen-containing gas as oxidizing means, which comprises extracting such mixture with concentrated sulphuric acid and separating sulphuric acid from the resulting sulphuric acid extract.

Lubricant—Patent #2,421,082—Mathias Pier and Friedrich Christmann, vested in the Attorney General of the United States. A composition of matter essentially comprising a mineral oil lubricant and a viscosity increasing agent soluble in said mineral oil and comprising a polymerization product obtainable by interpolymerizing a compound which is polymerizable by reason of having a double carbon linkage and which, when polymerized by itself by means of an acid-reacting inorganic halide, yields a product of molecular weight about 1000, with a hydrocarbon mixture containing unsaturated constituents and selected from the group consisting of cracking and dehydrogenation products of hydrocarbons and hydrocarbons obtained in the synthesis of benzine from carbon monoxide and hydrogen.

Cutting Oil Base—Patent #2,421,158—Latimer D. Myers and Victor J. Muckerheide, assignors to Emery Industries, Inc. A cutting oil base consisting essentially of approximately 40 to 50 parts by weights of potash rosin soap, 30 to 40 parts by weight of glyceryl mono oleate, an appreciable quantity, up to 5 parts of potassium oleate for emulsifying purposes and 5 to 10 parts by weight of water, the said composition also including from approximately 5 to 10 per cent by weight of oil soluble mineral oil sulphonates.

Cutting Oil Base—Patent #2,421,159—Latimer D. Myers and Victor J. Muckerheide, assignors to Emery Industries, Inc. A cutting oil base consisting essentially of approximately 45 parts by weight of rosin soap, 35 parts by weight of glyceryl mono-oleate, an appreciable quantity up to 5 parts by weight of red oil soap for emulsifying purposes, and approximately 5 to 10 parts by weight of water.

Horticultural Spray Oil—Patent #2,421,507—Paul R. Jones, assignor to Shell Development Co. A clear mineral oil horticultural spray containing dissolved a minor proportion exceeding its normal solubility in said mineral oil of rotenone and a minor but rotenone-solubilizing proportion of a mixture of polychrorinated alkanes and alkenes of from 3 to 4 carbon atoms.

Lubricant—Patent #2,421,543—James F. Cook, assignor to Union Oil Co. of California. A composition of matter comprising a lubricant of the class consisting of oils and greases and a small amount, sufficient to impart extreme pressure properties to said lubricant, of a finely divided, non-crystalline metallic sulfide dispersed therein.

Catalytic Treatment of Hydrocarbon Oils—Patent #2,421,616—Charles E. Hemminger and Edwin J. Gohr, assignors to Standard Oil Development Co. In a process for cracking hydrocarbon oils wherein the oil is cracked in the presence of a catalyst which continuously circulates through a cracking zone and wherein oils of different coking characteristics are passed through said cracking zone at different times, the improvement which comprises controlling the amount of catalyst in said cracking zone to convert a substantially uniform and predetermined amount of the oil into coke irrespective of the coke forming characteristics of said oil.

Lubricating Oil—Patent #2,421,631—Bert H. Lincoln and Gordon D. Byrkit. A lubricant comprising in combination a major proportion of oil of lubricating viscosity and a minor proportion, sufficient to stabilize said oil against oxidation, of a salt of a sulfurized relatively high molecular weight carboxylic acid, said carboxylic acid being unsaturated and being sulfurized by reaction with sodium pentasulfide.

Process of Producing Tall Oil Drying Oils—Patent #2,421,842—Frederick Charles Martin. In the process of treating tall oil, the step of esterifying said oil with at least one polyhydric alcohol in the presence of at least one siliceous catalyst.

Stabilized Lubricating Emulsions—Patent #2,422,075—Malcolm D. Bray, assignor to The Texas Company. A lubricating emulsion comprising an emulsion of mineral oil-in-water, a guanidine salt of a soap-forming saturated fatty acid, and an alkylolamine salt of an aliphatic monocarboxylic acid containing at least 10 carbon atoms, said alkylalamine salt being present in amounts sufficient to stabilize said emulsion at elevated temperatures.

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Process of Detecting Oil Dispersed in Well Drilling Fluids—Patent #2,422,852 — George L. Ratcliffe, assignor to National Lead Company.

The process of detecting oil during drilling of a well by the employment of a drilling fluid, comprising, contacting the drilling fluid from the well with successive parts of a record base preferentially affected by oil and marking the successive parts of the record base with the well depths corresponding to the marking of the medium by the oil.

Lubricating Oils — Patent #2,422,881 — Charles M. Blair, Jr., assignor to Petrolite Corp., Ltd.

A composition of matter, consisting of a mineral lubricating oil and a relatively small amount of an aliphatic saturated alcohol-alpha-beta unsaturated dicarboxy acid-unsaturated aliphatic alcohol condensation product; said alcohols containing at least 8 and not more than 22 carbon atoms; said acid having not over 5 carbon atoms and aid unsaturated alcohol having at least 3 intervening carbon atoms between the carbon atom to which the hydroxyl group is attached and the nearest ethylenic carbon atom; said condensation product resulting from a reaction in which the molal proportions of the alpha-beta unsaturated dicarboxy acid to the unsaturated alcohol are within the range of about 1.5 to 2.5 and the saturated alcohol reactant is such that the total equivalents of alcoholic reastants is about equal to the equivalents of dicarboxy acid used; said additive being present in amount carrying from 0.025 to about 5%, by weight, on the basis of the lubricating oil with which it is admixed.

Emulsifiable Hydrocarbon Oils and Emulsions Thereof—Patent #2,423,144—George W. Gregg, assignor to Shell Development Co.

An emulsifiable oil comprising a major proportion of a hydrocarbon oil having dissolved therein an organic oil-in-water emulsifier and an alkali metal polyorthophosphate having the general formula

$$Na_nP_n—_2O_{3n}—5$$

wherein n is an interger greater than 5 and in an amount sufficient to stabilize an oil-in-water emulsion of said emulsifiable oil.

Method of Treating Tall Oil—Patent #2,423,236—James Harwood and Evan Francis Binkerd, assignors to Armour and Co.

A process for producing hydrogenated tall oil acids comprising treating tall oil acids with an alkaline material in an amount insufficient to saponify more than 5% of said acids, and hydrogenating the tall oil acids so treated.

Process for Breaking Petroleum Emulsions — Patent #2,423,364 — Charles M. Blair, Jr., and Dale M. Schulz, assignors to Petrolite Corp., Ltd.

A process for resolving petroleum emulsions of the water-in-oil type, characterized by subjecting the emulsions to the action of a demulsifying agent comprising a sub-resinous esterified adduct, being a member of the class consisting of complete esters, acid esters and ester salts; said adduct being an acyclic alpha-beta unsaturated acid having not over 10 carbon atoms combined at an intermediate point in the carbon atom chain of a non-conjugated, unsaturated, non-hydroxylated, fatty acid acyl radical having at least 8 and not over 32 carbon atoms; said esterified adduct containing at least one occurrence of the radical

$$—C00.(CnH_2n0)m''Z'$$

in which n represents the numerals 2 to 4, m'' the numerals 4 to 20, and Z' is a member of the class consisting of alkyl radicals and acyl radicals having not over 8 carbon atoms.

Petroleum Distillate and Method of Improving—Patent #2,423,406—Eugene T. Scafe and Jorn Herman, assignors to Socony-Vacuum Oil Co.

The method of stabilizing a light petroleum solvent which, when boiling, normally causes substantial discoloration of a copper strip immersed therein for 30 minutes, which consists of admixing with said solvent a minor proportion, from about 0.001 to less than 0.5%, by weight, sufficient to inhibit said discoloration, of a compound characterized by the general formula:

$$R—SH$$

wherein R is an aromatic radical selected from the group consisting of alkyl substituted and unsubstituted—phenyl, naphthyl and diphenyl radicals, and wherein the sulfur of the —SH group is linked to a nuclear carbon atom of said aromatic radical RR, the sulfur present in said compound being only in the form of R—SH.

Electrical Insulating Oils—Patent #2,423,413—Frank J. Soday, assignor to The United Gas Improvement Co. As a new composition of matter, an electrical insulating oil comprising castor oil and an aromatic hydrocarbon oil boiling above 210°C., having a mixed aniline point below 15°C., and separated from petroleum oil gas tar. An electrical conductor insulated by material comprising an aromatic hydrocarbon oil boiling above 210°C., containing a mixture of aromatic hydrocarbons constituting at least 95% thereof, having a mixed aniline point below 15°C., and separated from petroleum tar produced in the vapor phase pyrolysis of petroleum oil.

Oil Determination—Patent #2,423,774—John J. Heigl, assignor to Standard Oil Development Co. A method for determining the amount of mineral oil of known character in a substance containing it, which comprises preparing a plurality of solutions of varying concentration of said oil in an oil solvent, determining the amount of light of a selected wave length from the near ultra-violet range absorbed by each solution, preparing a graph by plotting oil concentration in solution in the solvent against the log of Io/I, where Io is a figure representing the amount of light of the selected wave length absorbed by the solvent per se and I is the amount of light of the same wave length absorbed by any given solution, extracting the oil from the substance containing it with the same oil solvent as was used for preparing the graph, determining the amount of light of the selected wave length absorbed by said extract and determining by reference to the graph the concentration of the oil in the extract.

Pour Point Depressants for Lubricating Oils—Patent #2,423,789—Thomas G. Murphy and Jacob Faust, assignors to L. Sonneborn Sons, Inc. A pour point depressant composition for addition to a wax containing petroleum hydrocarbon oil having normally a relatively high pour point due to the wax contained therein comprising in excess of 30% petroleum hydrocarbon oil carrier, and substantially dissolved therein approximately 4 to 48% aluminum stearate and approximately 2 to 15% phosphorous pentasulfied reacted alkali metal petroleum mahogany sulfonate.

Timepiece Lubricant—Patent #2,423,844—John D. Morgan and Russell E. Lowe, assignors to Cities Service Oil Co. A lubricant for timepieces and the like comprising from 60—80 parts by weight of tricresyl phosphate (M. P.), from 25—7 parts by weight of ethylene glycolmonoethyl ether ricinoleate, and from 15—13 parts by weight of triethylene glycol di-2-ethylbutyrate.

Process of Refining a Petroleum Oil Containing Naphthenic Acids—Patent #2,424,158—Mack C. Fuqua and John B. Lovell, assignors to Standard Oil Development Co. The process of refining a crude petroleum oil which comprises subjecting it to continuous counter-current extraction with a solution consisting of an alkylol amine dissolved in a low molecular weight water-soluble oxygen-containing organic solvent to remove naphthenic acids substantially completely from said crude oil, whereby said crude oil is made substantially acid-free and substantially non-corrosive during storage and subsequent distillation and refining treatments, separating the solvent extract now comprising solvent and dissolved therein alkylol amine salts of naphthenic acids together with any unreacted alkylo lamine, treating said solvent extract with carbon dioxide to convert said alkylolamine naphthenates into corresponding alkylolamine-carbonates and liberate free said liberated naphthenic acids from said solvent solution of alkylolamine and carbonates thereof, separating naphthenic acids which are insoluble in the solvent solution containing alkylolamine-carbonates and heating said solution to drive off carbon dioxide from said carbonates, thereby regenerating alkylolamine in solvent solution, and finally recycling said alkylolamine in solvent solution.

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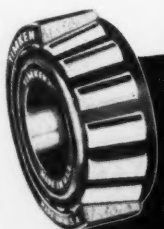

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Lubricating Oil Composition—Patent #2,422,278—David W. Young and John D. Calfee, assignors to Standard Oil Development Co.

A lubricant comprising in combination a hydrocarbon oil and a dissolved viscosity index mproving amount of a reaction product of polymerized methyl pentadiene having a molecular weight within the range between 8,000 and 25,000 in combination with maleic anhydride.

Lubricant—Patent #2,422,585—Thomas H. Rogers and James W. Starrett, assignors to Standard Oil Co.

An oleaginous composition comprising a major proportion of a hydrocarbon oil and in combination therewith from about 0.10 to aobut 5% by weight of a sulfurized terpene and from about 0.001 to about 10% by weight of the neutralized reaction product of a phosphorus sulfide and a hydrocarbon.

Preparation of Lubricants—Patent #2,422,630—John M. Musselman and Herman P. Lankelma, assignors to The Standard Oil Co.

A process of preparing a product suitable for use as a lubricant and as an addition agent to improve lubricating oils, which comprises heating an organic thiophosphate reaction product of a phosphorus sulfide and an aliphatic oxygen-containing organic compound to a temperature above 275°F. for a length of time to form a separable sludge containing phosphorus, and a desired decomposition product having a phosphorus content of less than half that of the thiophosphate starting material and most of the sulfur content thereof, and separating said desired decomposition product from the sludge so formed during the heating.

Lubricant—Patent #2.422,769—Edward S. Blake and Kenneth L. Godfrey, assignors to Monsanto Chemical Co.

A composition of matter comprising a major proportion of a lubricating oil and in admixture therewith in such proportion that extreme pressure properties are imparted to the oil a chlorbenzyl ester of an alkyl xanthic acid, the chlorine being linked to the phenyl nucleus of the said benzyl group.

Process for Breaking Petroleum Emulsions — Patent #2,422,822—Charles M. Blair, Sr., assignor to Petrolite Corp., Ltd.

A process for breaking petroleum emulsions of the water-in-oil type, characterized by subjecting the emulsion to the action of a demulsifying agent, comprising an adduct selected from the class consisting of acids, esters, anhydrides, and salts; said adduct being an acylic alpha-beta unsaturated acid having not over 10 crbon atoms combined at an intermediate point in the carbon atom chain of a non-conjugated, unsaturated, non-hydroxylated, fatty acid acyl radical having at least 8 carbon atoms and not over 32 carbon atoms; said acyl radical being a constituent part of a member of the class consisting of salts, acids, and esters.

Lubricants, etc., Containing Waxy Hydrocarbons and a Ketone-Aromatic Condensation Product as Wax Modifier—Patent #2,422,247—Eugene Lieber and Aloysius F. Cashman, assignors to Standard Oil Development Co.

An oil composition comprising a hydrocarbon oil base and a small proportion of a wax modifier consisting essentially of a Friedel-Crafts condensation product of an aliphatic ketone having less than 10 carbon atoms with a low molecul weight aromatic compound having the general formula ArRn, where Ar represents an aromatic nucleus, at least one R is replaceable hydrogen and the other R's are selected from the group consisting of hydrogen, halogen, alkyl, aryl, aralkyl, alkoxy and hydroxy radicals, n representing the number of R radicals, said condensation product being substantially nonvolatile under fire and steam distillation conditions at temperatures up to 600° F.

Compounded Lubricating Oil—Patent #2,422,275—Carl Winnin gand Dilworth T. Rogers, assignors to Standard Oil Development Co.

An organic composition consisting essentially of an oil containing from 0.02 to 15% of a product obtained by reacting from about 1 to about 3 molecular proportions of a compound selected from the group consisting of aliphatic and alicyclic compounds containing an unsaturated carbon-to-carbon linkage, at a temperature of about 20° to about 140°C., with 1 molecular proportion of a sulfur halide, and further reacting from about ½ to about 10 molecular proportions of the product thus formed with one molecular proportion of an aromatic compound at a temperature of about 40° to about 160°C.

Compounded Lubricating Oil—Patent #2,422,276—Louis A. Mikeska, assignor to Standard Oil Development Company.

A liquid hydrocarbon product consisting essentially of a mineral oil and 0.02 to 15% of a product obtained by reacting from about 1 to about 3 molecular proportions of a compound selected from the group consisting of alipdatic and alicylic compounds containing an unsaturated carbon-to-carbon linkage, at a temperature of 20 to 100°C., with 1 molecular proportion of a sulfur halide, and further reacting from about ½ to about 10 molecular proportions of the product thus formed, at a temperature of about 40 to about 160°C. with a compound of the formula

R—Ar—OT

where ARR is an aromatic nucleus, R represents at least one aliphatic side chain consisting essentially of an alkyl group having at least 20 carbon atoms, and T is a member of the group consisting of hydrogen and metal equivalen s of hydrogen, the metals being those of groups II, III, IV and VIII of the periodic table.

Essential Oil Compositions—Patent #2,422,145—Walter A. Taylor, assignor to Atlas Powder Company. A composition comprising a clear, stable solution of a quantity of an essential oil and at least an equal quantity of a water-soluble hydroxy polyoxyethylene ether of a partial higher fatty acid ester of a low molecular weight polyhydroxylic compound, the said solution being capable, upon dilution with water, of forming a clear, stable aqueous dispersion of said essential oil and hydroxy polyoxyethylene ether.

Process for Breaking Petroleum Emulsions—Patent #2,422,177—Charles M. Blair, Jr., assignor to Petrolite Corp., Ltd. A process for resolving petroleum emulthe emulsions to action of a demulsifying agent comprissions of the water-in-oil type, characterized by subjecting ing a sub-resinous esterified adduct, being a member of the class consisting of complete esters, acid esters and ester salts; aid adduct being an acyclic alpha-beta unaturated acid having not over 10 carbon atoms combined at an intermediate point in the carbon atoms chain of a non-conjugated, unsaturated, non-hydroxylated, fatty acid acyl radical having at least 8 and not over 32 carbon atoms; said esterified adduct containing at least one occurrence of the radical.

Method of Preparing Composition of Matter Suitable for Use as a Lubricant and as an Addition Agent to Lubricants—Patent #2,422,206—John M. Musselman, assignor to The Standard Oil Co.

In a process of forming a composition of matter suitable for use as a lubricant and as an additive for mineral oils to improve their lubricating properties, in which process a phosphorous sulfide is reacted at a temperature of at least about 270° F. with an ester type wax, and in which process the amount of the phosphorous sulfide is at least about the amount required to complete the reaction that occurs at said temperature, the improvement which comprises carrying out said reaction while the reacting ingredients are diluted with at least about 10% of a mineral oil to improve the yield of the reaction product and minimize the formation of a phosphorous and oxygen-containing by-product.

Lubricating Composition—Patent #2,422,243—Amos T. Knutson and Eldon F. Graves, assignors to The Lubri-Zol Corp.

A lubricating composition comprising a major proportion of mineral lubricating oil and an amount sufficient to impart extreme pressure properties of a compound represented by the formula:

R—S—O—R'
‖
O

where R is an aliphatic substituted aromatic radical, and R' is selected from the class consisting of hydrogen, organic radicals, and basic radicals.

N. L. G. I. Meeting

The Board of Directors of the National Lubricating Grease Institute met in Hot Springs, Virginia, recently. They adopted a new constitution and by-laws which had previously been approved by the entire active membership of the N. L. G. I. by written mail ballot. The Board made provisions in the budget to take care of the enlarged and improved "Institute Spokesman," official publication of the Institute. Approved a general outline for the program of the Fifteenth Annual N.L.G.I. Convention scheduled for the Edgewater Beach Hotel in Chicago, October 16th-18th, 1947.

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(*Continued from page* 23)

data between the 36-hour Chevrolet Engine test and the one-cylinder Lauson Engine.

4. Literature survey with detailed patent reference is given for chemicals used in Engine Preservatives.
5. The electrochemical theory of corrosion and theoretical means of corrosion prevention are discussed.

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(*Continued on page* 45)

LUBRICATION FOR MOST INDUSTRIAL NEEDS

Bowser Lubricating Systems are supplied in any capacity for any job requiring circulating, filtered lubricating oil.

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Machine Tool Lubrication from the User's Point of View

By W. H. McKAIG

Lubrication Engineer, International Business Machines Corporation
Endicott, New York*

MACHINE tool lubrication can very well be considered PRODUCTION INSURANCE. We are all aware that, with our present day tightly coordinated manufacturing schedules, lost machine time is like a disturbing wave that travels clear down the line to the shipping platform. The boom of the resulting breaker is generally well amplified by the customer who didn't get the product in the right quantity —at the right time—at the right place, because the proper lubricant was NOT applied in the right quantity—at the right time—at the right place. It is remarkable that a silent bit of lubricant which wasn't there could make so much racket.

Top management of my own Company, IBM, believes strongly that this form of PRODUCTION INSURANCE is so worthwhile that a separate and clearly defined Lubrication Department was set up about three years ago. This department is directly responsible to Top management for all Plant lubrication and its twin brother, cutting fluid control. Let me emphasize that along with this responsibility the very necessary managerial authority was delegated to the head of this department. This authority includes control of specification and selection of the lubricants and coolants used, management of the personnel applying these materials and the selection and operation of equipment used in their application, reclamation, and storage.

With Top management convinced, the Lubrication Engineer still has a tough selling job ahead of him. He must sell himself and his services so well that the departmental Manager and the machine operator (and the last is by no means least) relies on the Lubrication Department for the ultimate in machine service and machining results. It is common knowledge that without the whole-hearted cooperation of the machine operator, no laboratory conclusion can be duplicated on the production line. Let me say that at IBM cooperation is not a catchword but an everyday habit.

To get truly wholehearted cooperation the Lubrication Engineer must approach a problem with a patently open mind. This not only is the most effective approach as a technical thinking procedure, but it almost automatically engenders a like open mindedness in those from whom continued cooperation is so essential. In reaching your conclusion you take the other fellow along with you. He feels, and rightly, that he has a personal part in making the improvement and pride in making the change really work is a natural result. As you know, this is only elementary sales psychology. You and he start from a series of mutually understood facts and step by step go through the practical and technical thinking that brings you both to the conclusion. Of course the other fellow may not be able to follow you completely through the technical part of the discussion but psychologically he has very painlessly been led from what he knew, through what he didn't know, to a conclusion. That makes it his conclusion too and, believe me, he is going to make the change work, or else! Let me most emphatically recommend this procedure not only to help get the desired cooperation but to forestall possible erroneous snap judgment on your part. It is really a small premium to pay to make your PRODUCTION INSURANCE policy sound.

In order to get cooperation you must give it. Whether it is tooling for new parts, retooling for improved processes or improved tooling which may involve anything from a simple jig to the design of a complete special machine tool, you as the Lubrication Engineer will insure yourself against many a future headache by close cooperation with your Tool Engineering Department. Cooperation with your Plant Engineering Department to get the best machine floor layout will certainly pay off in ease of machine servicing. Our lubrication men check over every machine they service and it is surprising the number of minor faults they discover in time to prevent major breakdowns. These are reported promptly to the Machine Repair Department and adjustments are quickly made. Machine Repair, in turn, works closely with us in reporting cases where improvements in lubrication are indicated.

To make this PRODUCTION INSURANCE effective we must tie our efforts in with our purchases of new machine tools. New machines going into our line should improve Maintenance of Production in that they will require less mechanical maintenance through better design including centralized lubrication systems which will provide safe lubrication for not less than a one shift interval. We feel that any machine tool manufacturer who will not offer, at least as an alternate, a system of lubrication which will provide such safe shift-interval lubrication is negligent. With obvious increased man-hour most of all types of service, a slight increase in capital cost can well be justified. Is it any wonder that our Equipment Engineer who handles purchases of new machines checks with the Lubrication Engineer before purchase of these machines?

At this point, I believe machine tool manufacturers could well give further thought to the problem of lubricant contamination. Many provide some sort of filter for circulated lubricants but in most part the filter will not do the job assigned to it. Several years ago we found that we were getting an expensive series of bearing failure in a group of multiple spindle automatic screw machines. When these machines were dismantled we found evidence of black iron oxide and no sure sign

*(*A paper presented at the May 15, 1947, Meeting of New York Section of the American Society of Lubrication Engineers.*)

of the cause. All the usual checks of lubricants were made and also a fly-trap test of atmosphere borne abrasives was conducted. These tests proved inconclusive and in desperation depth filters were installed on three of these machines. These filters were arranged to filter 100% of all the oil delivered to the bearings of the machine. Although we knew that we had by necessity operated these machines much beyond their design (about one-third the part tolerance and at much higher speeds) we hoped to reduce their down time. The results were amazing. We held to the specified tolerances, maintained spindle speeds, and kept thrust bearing adjustments to a negligible point. At the end of four months, with no sign of bearing failure, no deposit within the housing of the machines, and no change of color or Neutralization Number of the lubricant one of the filter cartridges was removed and sawed apart for inspection. It showed that only about one-quarter of its capacity was expended. Since then we have equipped all similar machines with this type filter and have had no spindle failures. Furthermore, we find we can run sixteen hours a day for a year without either a lubricant or filter cartridge change. We have concluded that in this group of machines a slight amount of cam wear was the "Typhoid Mary" which caused the epidemic. The infection of the life-blood of the machine can be prevented by effective filtration. A good filter is very cheap PRODUCTION INSURANCE.

Another type of contamination which is not controllable by filters is the contamination of the lubricant by the cutting fluid. It is surprising to find in otherwise good machine designs the location of the lubricant reservoir in such a position that cross contamination is inevitable. It would seem that the designer had wound up a job with a sigh of satisfaction only to discover he had a couple unplaced parts left over—a lubrication system and a coolant system. In order not to disturb the beautiful symmetry of his brain child he stuffed them in the only void he could find. For my part, I would prefer that he had hung them on the outside.

A similar point to which too much attention can not be given is adequate shielding and sealing of bearings and apertures exposed to cutting fluid. With our present high cutting speeds we really have to blast the cutting fluid into the work to get results. It doesn't take much chip laden fluid to ruin a bearing or to seriously contaminate the lubricant. In many cases the most economical machining job cannot be done because the most effective coolant would seriously jeopardize the bearings.

Contamination of the cutting fluid by the lubricant is no less annoying and costly from an operating standpoint. After carefully compounding a cutting fluid for a certain operation its effectiveness can drop off very rapidly by dilution. The cost of analyzing the fluid in individual machines to keep the compounding up to par is too high to be practical. Some machines, especially certain hydraulically operated ones, are outstanding offenders. They are designed so that any hydraulic leakage is carefully conducted into the coolant. A large part of this leakage could as easily and with safety be returned to the hydraulic reservoir.

At IBM this growth in volume of our cutting oils is not wasted. The excess accumulating in our central systems is removed and together with the oil recovered by chip extraction amounts to about 500 gallons per week. We have a small but adequate oil reclamation plant and there this recovered cutting oil is stripped and bleached by a contact process. The resulting straw-colored oil makes a good grade of blending oil easily compounded into a good cutting oil. This process not only saves the cost of disposal but provides blending oil at a cost just over 5 cents per gallon. By the way, we also reclaim all our recoverable lubricating and hydraulic oils and find the volume just sufficient to take care of the lubrication of non-critical points where the use of ordinary engine oil is indicated.

Our lubricant suppliers have cooperated extremely well with us in our program of more efficient utilization of lubricants and coolants. All major suppliers who maintain adequate warehouse service and technical representation in our area are assured of their fair share of our business and don't hesitate to suggest savings wherever they are apparent. We do not buy on price but on quality, and all we ask is that the price be fair and commensurate with the quality.

Access to all the available physical and chemical data concerning the product is necessary for its efficient application, and our suppliers have been very helpful in furnishing this information. The coordination of this data, the advice of the technical representative and the efforts of our own Research Laboratory have resulted in better lubrication and cutting results with fewer products at considerable reduction in over-all cost.

One of the most important of all the elements in the efficient operation of the machine tool user's Lubrication Department is the personnel of that department. We believe these men must have definite mental and physical qualifications for this work. They must have mechanical aptitude and initiative so that they will understand the machines they are servicing; they must be conscientious so that they may be trusted to perform their duties without continuous direct supervision; they must be physically able to service their assigned areas without undue strain; and, not least, they must have agreeable personalities so that the cooperation of the many machine operators they inevitably contact will be invited. We don't even call these men "oilers." We class them as Machine Servicemen, consider them skilled employees and pay them accordingly.

At this time I wish to thank our Machine Tool and Lubricant suppliers for their excellent cooperation in helping us to build an effective Lubrication Department and assure them that we will continue to cooperate wholeheartedly with them so that we can constantly improve PRODUCTION INSURANCE at IBM.

The National Office is in need of copies of Vol. 3, No. 1, February-March, 1947 of LUBRICATION ENGINEERING

We will pay 50c for each copy in good condition sent to this office.

Chemical and Physical Mechanism of Engine Preservative Oils

(*Continued from page 42*)

TABLE 1
Physical Requirements of Engine Preservatives

	U. S. Army 2-126		Army-Navy Aeronautical AN-VV-C-576	Bureau of Ships 52-C-18 Grade II
	Oils Ready For Use		Oil Type Additive Base	Film Forming Base in Solvent Vehicle
	Gr. I	Gr. II		
Flash Point °F. Min.	360	390	350	100
Visc. @ 130°F.	90-120	185-255	None	None
Visc. @ 210°F.	None	None	100-125[1] 90-100[2]	
V. I. Min.	55	55	95[3]	None
Pour Point °F.	-10	0	20[1] & 2	35
Sprayability	None		None	Must be sprayable at 40°F.
Film Thickness Max.	None		None	0.0010"
Color	None		None	Sufficient to be discernible

TABLE 2
General Chemical Requirements of Engine Preservatives

	U. S. Army		Army-Navy Aeronautical AN-VV-C-576	Bureau of Ships 52-C-18 Grade II
	Oils Ready For Use		Oil Type Additive Base	Film Forming Base in Solvent Vehicle
	Gr. I	Gr. II		
Volatile Matter % Max.	2	2	3[1]	Must conform with volatility of approved sample
Compatibility	With all 2-104 oils		With all AN-VV-O-446 oils	Film: With all Navy symbol 1120 oils
Corrosion	None		3 hrs. @ 212°F. on Copper	Steel, brass, copper, aluminum at room temperature throughout duration of protection test
Ash % Max.	None		1[1]	None
Foaming	None	Foam collapse as specified[2]	None	None
Precipitation No. % Max.	None		0.1[1]	None
Color indicating of Silica Gel	None		Must have no effect	None

TABLE 3
Protective Requirements of Engine Preservatives

	U. S. Army 2-126		Army-Navy Aeronautical AN-VV-C-576	Bureau of Ships 52-C-18 Grade II
	Oils Ready For Use		Oil Type Additive Base	Film Forming Base in Solvent Vehicle
	Gr.I	Gr.II		
HBr Neutralization	Must show no corrosion		Must show no corrosion	Must show no corrosion
Protection (Accelerated)	200 hrs. 100% RH @ 100°F. on sandblasted steel	200 hrs.	150 hrs. 100% RH[1] @ 120°F. on sandblasted steel	14 days 4% salt spray @ 100°F. on polished panels
Protection (Accelerated)	20 hrs. salt water immersion shall cause no corrosion		None	None
Protection (Accelerated) Heat Resistance	None		None	Exposure 8 hrs. @ 120°F. 30 min. 4% Salt Spray 5 days
Protection (Practical)	None		Tropical Room	Shed Storage

TABLE 4
Indicative and Actual Engine Test Requirements of Engine Preservatives

	U. S. Army 2-126		Army-Navy Aeronautical AN-VV-C-576	Bureau of Ships 52-C-18 Grade II
	Oils Ready For Use		Oil Type Additive Base	Film Forming Base in Solvent Vehicle
	Gr. I	Gr. II		
Effect on Engine Metals	Shall have a minimum effect on metals in engine assembly		No scouring, pitting, corrosion or black discoloration of bearings for 100 hrs. in Oil Work Factor Machine[1] & 2	No scouring, pitting, corrosion or black discoloration of bearings in Oil Work Factor[2]
Engine Test	36 Hrs. Chevrolet Engine Test according to AXS-1554		50 Hrs. Engine Endurance Test	None

TABLE 5
Engine Test Requirements as Described in AXS-1554

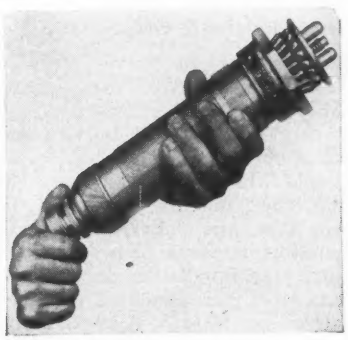
	Grade I	Grade II
Total Operating Time Hours	36	36
Engine Speed R.P.M.	3150	3150
Engine Load B.H.P.	30	30
Spark Advance °F.	52±5	52±5
Spark Plug Gap Inches	0.040	0.040
Intake Air Temperature °F.	80	80
Coolant Temperature °F.	200	200
Crankcase Oil Temperature °F.	265	280
Air Fuel Ratio	14.5	14.5

Improved Design Wheel Bearing Packer Lincoln Kleen-Pak Model 820

The Lincoln Engineering Company, St. Louis, Missouri is now manufacturing a new, improved design faster, positive lubrication. It will service roller or ball Wheel Bearing Packer. The Kleen-Pak Wheel Bearing Packer is specifically engineered to provide cleaner, type bearings on all makes of passenger cars and light trucks. When packing roller-type bearings, the bore of the bearing and retaining cone of packer head is left free of lubricant—eliminates waste and mess.

The unit is manually controlled, screw-type operated and does not require extra guns or attachments. Quickly filled by suction, it holds ¾ lbs., enough lubricant to pack 40 average size bearings. Compact, fully portable—packs bearings right at the wheel.

The Lincoln Model 820 Kleen-Pak Wheel Bearing Packer has many outstanding features, and the manufacturer, Lincoln Engineering Company, St. Louis 20, Missouri will gladly send descriptive Bulletin No. 507 upon request.



A. S. L. E. Exhibitors at Machine Tool Show

D. A. Stuart Company

The exhibit of the D. A. Stuart Company booth No. 317L at the Machine Tool Show will focus attention on the solutions of daily production problems of metal working plants by showing "typical" parts machined with their products.

Complete descriptive data regarding the operation of machine tools, booklets on the latest information on metal cutting, grinding and many other operations, will be available.

The proximity of the Stuart plant and laboratories to the show site offers an excellent opportunity for men of the metalworking industry to take advantage of a cordial invitation to visit their lubricant plant and laboratories. The many testing devices and other interesting machines in the Stuart laboratories will be shown in operation.

Samples of "Centerlube" will be distributed in special direct applicator tubes.

Madison-Kipp Company

BOOTH No. 450

They are featuring six models of "fresh oil lubricators." These will be manually operated for display purposes. New developments in their special off hand high-speed grinders will also be on display.

Mr. A. C. Lillegren, Vice-President in charge of sales, will be seen at the booth frequently to welcome his many friends.

The exhibit will be in charge of: Mr. J. A. Courter, Eastern Manager; Mr. W. C. Coles, Chief of the Lubrication Division, and Mr. V. T. Kitson, in charge of Grinder Sales.

News Release From the Trabon Engr. Corp., Cleveland, Ohio

Trabon Engineering Corp., Cleveland, Ohio, announces that the Trabon Type M positive feed centralized lubricating systems will be shown on machinery manufactured by the National Machinery Company of Tiffin, Ohio, and the Ajax Manufacturing Company of Euclid, Ohio, at the Machine Tool Show. Trabon points to an installation on a 2-inch Ajax Air-Clutch Operated Forging Machine, a 500-ton Ajax High-Speed Forging Press and a 1½-inch high speed Maxi-Press, operated in the National Machinery Company exhibit.

E. F. Houghton & Company, Philadelphia 33, Pa.

E. F. Houghton & Company announce the showing of three principal groups of products used in maintenance and operation of machine tools at the National Machine Tool Show, booth 47-D. These include cutting oils, lubricants and packings.

Mr. D. J. Richards, Vice-President of Sales; Frank Ross, Manager of the Lubricant Department; Mr. A. A. Miller, Chicago Manager of Sales; J. N. Smith, Manager of Hydraulic Packings Division; C. R. Schmitt, Lubricant Manager; A. J. Zino, Jr., Lubrication Manager of the Eastern Division; C. S. LaTour and J. T. Elliott, Lubricant Engineers; J. Samter, Hydraulic Engineer, and D. C. Miner, Advertising Manager, will be in charge of the booth and prepared to answer all questions.

The Houghton lubrication engineers will maintain a mobile service at the show to provide lubricants and advice on lubrication problems to exhibitors desiring such aid and they issue a cordial invitation to any machine tool manufacturer requiring this type of service to give them a call. Supplies not carried in the Houghton booth will be available in a few hours from the company's Chicago Plant.

Gits Brothers Company

Emphasizing the absolute completeness of the 1947 National Machine Tool Show is the exhibit of this Company, well-known manufacturer of lubricating devices for over 40 years. A complete presentation of the many Gits products has been assembled on an endless moving conveyor, affording visitors to the booth a splendid opportunity to view the very latest in lubricant equipment, from the smallest oil cup to the more complex and centralized automatic oiling systems. Particular attention is called to the display of the Constant Level Oiler and high speed oil seal in which the special features of these two products are graphically portrayed.

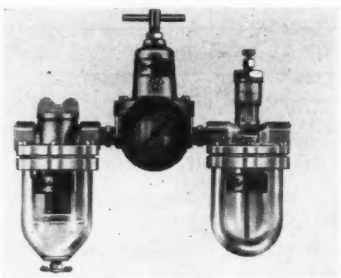
The Gits Brothers display will be under the direction of General Manager Frank Kovarik, who is widely known in lubrication circles. He will have at all times the entire staff of executives and engineers of broad training in lubrication problems. Mr. Kovarik will be glad to welcome his many friends of the A.S.L.E.

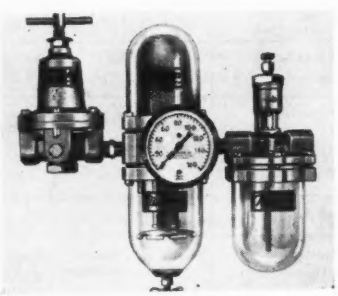
C. A. Norgren Company, Denver 9, Colo.

C. A. Norgren Company announce a series of Spindle Lubrication Units specifically designed for high speed spindles.

This unit is produced in two types.

When connected in the air line, either unit will provide lubrication





not affected by centrifugal action of high speed rotation.

These units will be on display at the Machine Tool Show with their other varied lines of lubrication equipment. Booth 37-A.

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Socony-Vacuum Company, at Booth No. 33, will feature their entire line of plant lubricants and metal processing oils and solubles. Mr. R. Q. Sharpe of the New York Engineering Department, formerly of Chicago, will be on hand to welcome his many friends, together with Mr. B. F. Wilson of the Chicago Division. A staff of engineers will be on duty constantly for advice and counsel on matters pertaining to cutting oils, hydraulic oils and coolants, as well as the general line of gargoyle lubricants.

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(*Continued from page* 13)

lated to a certain extent to the degree of refinement selected as optimum in that particular instance.

(l) Floc Test for Wax: A very useful method developed to determine the "waxing tendency" of refrigerator oils is commonly referred to as the "floc test." A mixture of 10% oil and 90% Freon 12 refrigerant held in a suitable gas-tight, thick-walled tube, is gradually cooled in a suitable cooling bath. The temperature at which a flocculent's separation occurs is called the "floc" or "waxing" point. The best refrigerator oils will remain bright down to temperatures of –50 F, and lower, and in actual operation these oils function satisfactorily at temperatures of –100 F. The following tabulation indicates the comparative "waxing tendency" of two typical commercially used oils:

Temperature	*Oil "A"*	*Oil "B"*
0 F	Bright	Bright
–20 F	"	"
–30 F	"	Cloudy
–40 F	"	Floc
–50 F	"	"
–60 F	"	"
–70 F	"	"

(m) Volatility: Volatility of an oil should be such that it will not vaporize excessively at pressures and discharge temperatures involved in a refrigerating system, and carry over into the expansion coils. Therefore it is essential that extreme ranges of viscosity be avoided such as in certain blended oils.

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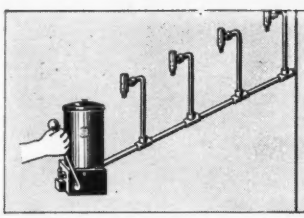

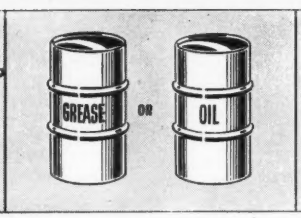

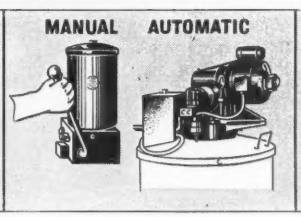

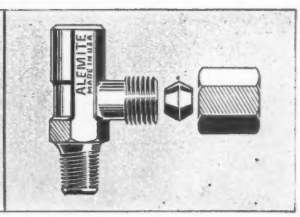

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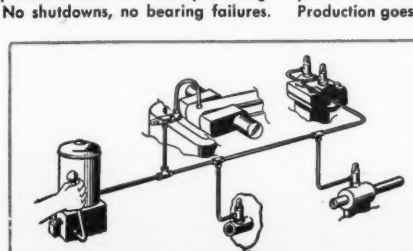

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